PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

April, 1939

A. PRESCOTT FOLWELL, Editor — VOL. 70. NO. 4 — W. A. HARDENBERGH, Asso. Editor

Contents

EDITORIAL 19

GENERAL:

Folwell Elected Honorary Member of APWA 18
Allotment of PWA Projects 22

HIGHWAYS AND STREETS:

A Fireproof Garage Built From Old Paving Brick. *By M. J. McGruder* 12
A Highway for Pleasure Only 16
Reports on English Road Research 17
Maintenance of Treated Timber Bridges. *By W. A. Stacey* 20
Permanent Colored Asphalt Road Markers 22
How to Maintain Highways and Streets. *By W. A. Hardenbergh* 24
A New Type of French Road Surfacing Material 51
California Developments in Road Markers 51

SEWERAGE AND SANITATION:

How Moisture Content of Sludge Affects Digestion 14
A New Type of Sewer Form Saves Money on Construction 18
Taking the Rattle Out of Manhole Covers. *By R. V. Terrill* 33
The Sewerage Digest. *By A. Prescott Folwell* 36
Suggestions for Planning an Incinerator 44
Transporting Sand in Pipe Lines 45
Sewage Disposal in Unsewered Areas 46

WATER SUPPLY AND PURIFICATION:

Probability of Recurrence of Ohio River Floods. *By C. Frank Johnson* .. 9
Laboratory and Plant Trials for Chemical Coagulation. *By F. K. Burr* .. 21
Brom-Cresol Green—Methyl Orange as Alkalinity Indicator. *By F. M. Hull* 34
New York Regulates Addition of Chemical to Water Supply 34
Washing Sand Filters—Hartford Data 35
Algae Control With Potassium Permanganate 35
The Water Works Digest. *By A. Prescott Folwell* 40
Recovery for Water Supplied Inside City Limits 43
Engineer's Fees for Abandoned Water Project 43

DEPARTMENTS

Keeping Up With New Equipment 52
The Engineer's Library 58
Readers' Service Section 52

TIMEWASTERS

Discussion:

So many conventions make the mistake of having papers first and then the discussion. It is our own idea that if the discussion was held first, the paper often wouldn't be needed. Mr. Blunk, in telling us that there are two possible answers to the Scotch problem of last month (20 men, 14 women and 3 children, or 23 men, 6 women and 8 children), said that he hoped this Scotch party would have a pleasant *week* at the fair. Messrs. Eaton and Bray agree.

Mr. Boyer writes in to say that Brer Wheeler must have had a tough time getting around "Devil's Elbow" or whatever they call it up there in N. H., but agrees that 9 chords, 19 ft. long with a radius of 109 ft. is OK. And Mr. Wheeler says he is afraid that either I gave his problem slightly incorrectly or Mr. Blunk got one of the chords twisted a bit; and he goes on to state that he wants to hear more from some of those "... didn't seem hard to some" that I am losing around my desk, because he is intending to see this important Western Hemisphere conflict carried through to a just end. Well, gentlemen, the original problem appeared in February *Timewasters*.

It has been stated that it is not possible to arrange the ten digits so they will add up to 100 without having fractional numbers, as 21 3/6 plus 78 45/90; but Mr. Bray from out in Minnesota has this simple solution: $(9X8)+7+6+5+4+3+2+1+0 = 100$. Looks like this answer is the goods. He also says that he would solve Mr. Brady's sphere problem, but the frost boils are calling.

Application (as the Army says):

a. At what rate must a standard bucket of water be whirled around a standard head so as to just prevent the water from falling out, the radius of the circle being 4 ft.? Thanks to *Clevaland Engineering*.

b. And Mr. Bray contributes what he calls an "old one": A man hired an engineer to lay out his grounds. He had 12 trees to be planted and he insisted that they be arranged in such a way that he would have 6 rows with four trees in each row." How did the engineer work this out?

c. Mikey counted his change and found that he had $4.40, all in quarters and dimes. He owed Ikey some money and settled this by giving him 4/7 of his dimes and 2/3 of his quarters; by this arrangement, Ikey received the same number of dimes and quarters. How much did Ikey get? *W. A. H.*

SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

FOUNDED IN 1896

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 326 Bulkley Bldg., Cleveland, Ohio

Who benefits from SOFT, IRON-FREE CITY WATER? *Answer: Everybody in Town*

1. THE CITY DOES!
Benefits from municipal water conditioning begin right in the Water Department. Permutit ends frequent hydrant flushing. Keeps mains clean and scale-free, too. Eliminates customer complaints.

2. INDUSTRIES DO!
Power plants, paper companies, textile mills, countless others, simply have to have conditioned water. You can help present industries . . . you can attract new industries . . . with Permutit water conditioning.

3. TAXPAYERS DO! Permutit softened water is grand for washing, cleaning, bathing, cooking. And everyone saves real money on soap, fuel, clothing and plumbing repair bills.

TODAY over 400 Modern Cities Save and Smile with Permutit Conditioned Water

Yes, soft, iron-free water benefits everyone in town. It's one sure way to give savings and satisfaction to every taxpayer.

Write to Permutit today. There's no obligation, and it may pay you handsomely. Remember, no matter what is wrong with your water, whether it's hardness, iron, manganese, dirt, corrosion, bad taste or bad odor, Permutit can help your experts or engineers solve the problem. Permutit is the world's largest maker of water conditioning equipment. Address The Permutit Company, Dept. G4, 330 West 42nd Street, New York.

Permutit
The Water Conditioning Headquarters
over 25 years

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 52 to 57

PUBLIC WORKS Magazine • • APRIL, 1939

Vol. 70. N. 4

Probability of Recurrence of Ohio River Floods

By C. FRANK JOHNSON

Senior Engineer, Commissioners of Sewerage of Louisville, Ky.

THE unprecedented gauge heights reached by the disastrous Ohio River flood of 1937 appeared to take most, if not all, engineers and flood protection officials by complete surprise. There had been too much reliance on the previous recorded highest stage being "high water," and many flood protection works had been designed with the usual freeboard of from 2 to 5 feet above this assumed high water. Likewise, much building and other work had been based on this same assumed high water, although the probability of higher floods would have been apparent had certain calculations been made on the basis of well established practices.

Following the 1937 flood various opinions were expressed regarding the probability of recurrence of such a flood. At one extreme was the statement that such a high flood would never again be seen, this statement being based naively on the fact that before 1937 such a flood had never occurred *during the time of the white man's residence in the Ohio River valley*. At the other extreme was the expressed fear of those whose homes were in reach of the 1937 flood, namely, that such a flood might come again at any time. Strictly speaking, the latter viewpoint is absolutely correct, but the probability is that many years will pass before another such flood occurs. However, there is a strong probability that still higher floods will occur in the Ohio River at some future time. Indeed, it was plainly apparent to one in the Ohio River valley in January, 1937, that the river could at that time have continued rising and could have reached even higher stages had the incessant rains not stopped when they did.

What are the chances of recurrence of the 1937 flood, and what are the chances of a higher flood occurring in the Ohio River? An approximate answer may be found by use of the law of probability, employing so-called probability paper and the skew curve principle, following the method of treatment developed by Allen Hazen and explained in his book on Flood Flows[1]. Following is a calculation of these chances, using gauge heights (upper gauge) of the Ohio River at Louisville, Ky. It is thought that, in general, the results of this calculation apply to the entire Ohio River.

Probability curve determined by use of probability paper and skew curve principle indicates higher floods to come in the Ohio River valley. Application of this principle and the results of computations are given herewith.

The annual maximum gauge heights are listed in order of size, as shown in Table 1, column 4, and then plotted on arithmetic probability paper, this paper having the vertical lines spaced according to the probability curve tables, and arranged so that a line plotted to represent the summation of the probability curve will be a straight line. The horizontal lines of this paper are spaced uniformly. The decimal plotting position, P, for the various gauge heights are calculated as follows:

$$P = \frac{2m - 1}{2n}$$

when m = the rank of the term that is to be plotted, as shown in Table 1, column 2, and

n = the total number of terms in the series, in this case 73 years, as the records cover a period of 73 years.

Calculation of P is illustrated in Table 1, columns 2, 3 and 4, and the corresponding plotting of the annual maximum gauge heights is shown by the irregular line in Figure 1. Now if these gauge heights correspond strictly with the normal law of error, they would all be on a straight line when plotted on probability paper. It is seen in Figure 1 that the points do not plot on a straight line, but form an irregular line which approximates a straight line, having a moderate curvature. A smooth curve representing this irregular line will be the probability curve of future floods of the Ohio

[1] Allen Hazen, "Flood Flows," pages 13, 39, *et al.*

River at Louisville, Ky. A smooth curve could be drawn "by eye," but a curve so drawn would be of questionable value and it is better to determine a smooth curve based on mathematical considerations. In order to draw such a smooth curve, the "coefficient of variation" of the series of gauge heights, and the "coefficient of skew" of the resulting probability curve are calculated.

The coefficient of variation gives the inclination of the desired smooth curve, indicating the ratios of large floods to average ones, while the coefficient of skew gives a measure of the curvature of the desired line, upward or downward. The necessary calculations to determine these coefficients are made in accordance with methods commonly used in statistical work (in the manner described in Flood Flows), and are illustrated in Table 1, columns 5 to 9, and in the computations immediately following Table 1.

By use of the coefficients so determined, the calculation of plotting points to draw a smooth curve can be made, as shown in Table 2. The resulting smooth curve (Curve A in Figure 1) is drawn through points plotted to represent the values shown in the first and last columns of Table 2. This curve represents the probable percentage of future years in which any gauge height will be equaled or exceeded, and, therefore, the probable average number of years between floods to or above any height. It must be emphasized and remembered that the indicated number of years is not the expected interval between floods, as some think, but is merely the probable long-time *average* interval between such floods, and that a flood to any height might possibly recur in a short period of 2, 3 or any other number of years.

Examining Curve A it is seen that the average interval between floods equal to or exceeding the 1937 flood (Louisville gauge height = 57.1) will probably be about 280 years (indicated on the horizontal scale at the top of the Figure), and that the average interval between floods equal to or exceeding the highest flood recorded before 1937 (Louisville gauge height = 46.7) will probably be about 35 years. Most disconcerting, however, is the indication that once every 1,000 years, on the average, the Ohio River will probably rise to a height about 6 feet higher than the 1937 flood, and once every 2,000 years, on the average, will probably rise to a height about 9 feet higher than the 1937 flood. This should give pause to everyone concerned, as any of the higher floods might occur at any time, and even the 2,000-year flood might possibly, but not probably, occur in 2 successive years. Even though such long-range predictions are probably not accurate and may be upset by unpredictable factors, nevertheless they indicate strong possibility of greater floods to come.

Flows Based on 1937 Flood

An interesting sidelight on Curve A is presented by calculating another plotting position for the 1937 flood, based on its being the maximum flood occurring within 160 years. This is known to be true, as Louisville has been inhabited since 1779, during which time no such flood occurred prior to 1937. Calculated in this way the plotting position of this flood would be 0.31 instead of 0.68, which indicates a probable future interval of about 320 years between floods to such height. The revised plotting position of the 1937 flood is shown in Figure 1 (slightly to the left of the original computed position), where it is seen to check very closely with Curve A, indicating that the 1937 flood was really not out of line with past floods when plotted in this way.

It is interesting to see what calculations of Ohio River flood probabilities made *before* the 1937 flood would have shown. Curve B in Figure 1 shows a portion of a probability curve determined in the same manner as Curve A, but based on records of only 71 years ending 1936. This curve (B) indicates that even before the 1937 flood, engineers should have realized the probability of occurrence of floods at least 10 feet higher than ever before experienced. This is approximately the height reached by the 1937

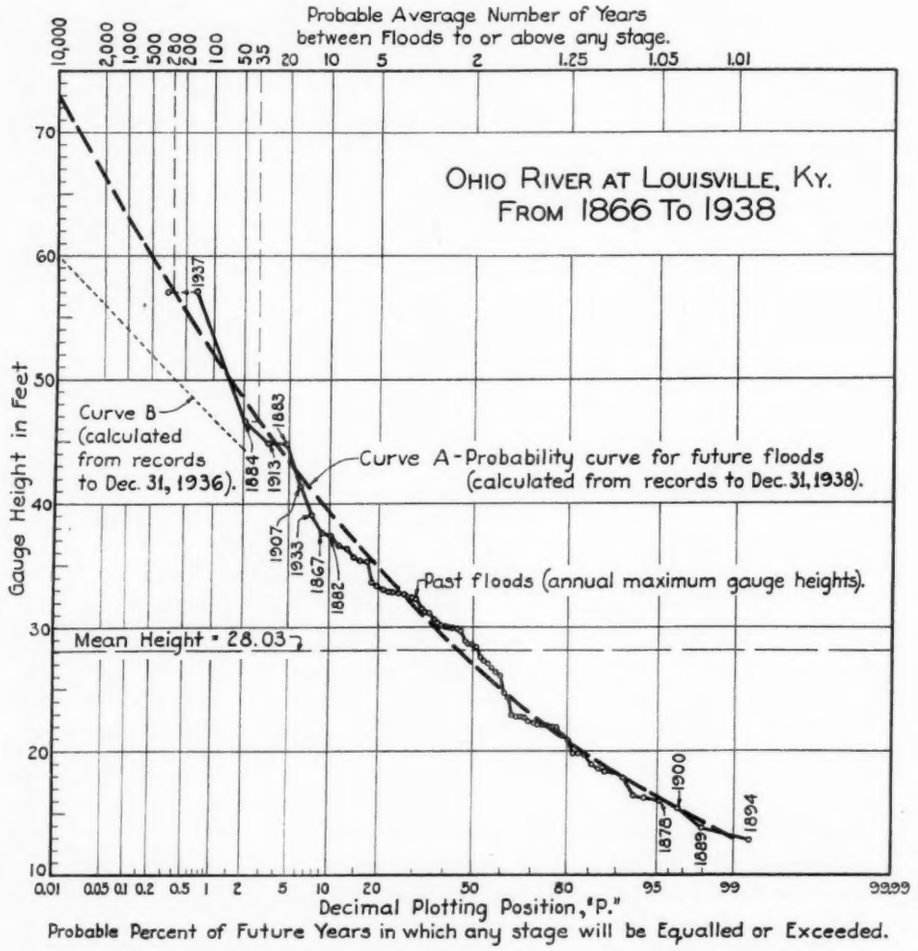


FIG. 1—FLOODS OF THE OHIO RIVER AT LOUISVILLE, KY.

In the center of Louisville during the 1937 flood.

flood. The coefficient of skew of Curve B is low (0.23), which, according to Hazen's conclusions, indicates that the record of floods up to Dec. 31, 1936, was deficient in large floods or had less than the normal number of high floods. In other words, one should have expected higher floods in the future than Curve B indicated, and the 1937 flood would not have been so unexpected.

Effect of Dams and Control Works

Use of records of past floods in calculating the probability of future floods of the Ohio River may be questioned by some who think that navigation dams and other works constructed during recent years in and along the Ohio River tend to increase materially flood heights. No marked tendency in this direction seems to be indicated by the records. From Table 1 it is seen that, of the 8 highest floods recorded at Louisville, 4 occurred during the first half of the 73-year period of record and 4 occurred during the last half of the period. Most of the regulation of the river by navigation dams has been done during the last half of the period under consideration, without increasing the number of large floods occurring. However, future flood heights may be affected by construction of flood protection dams, power dams or levees. In this connection a word of warning should be given about using gauge heights for probability studies when changes in the stream channel have been or may be made by man. In such cases the water quantities should be used and, when desirable, translated into gauge heights.

It is thought that in view of the current widespread interest in flood protection work, more general use could be made of probability paper and the skew curve principle to predict chances of probable future floods. Flood protection works based logically on such predictions, considering also other pertinent factors, should afford the maximum protection to which people and property are reasonably entitled. Predictions of probable floods by this method should, however, not be taken as being definite and final, but should be used as aids to judgment. Modifying conditions and data from other streams should be applied as may seem desirable.

TABLE 1

Calculation of decimal plotting positions and of coefficients of variation and skew for floods of the Ohio River at Louisville, Ky., for 73-year period ending 1938.

Year	Rank, m	Decimal position for plotting, P	Gauge heights in order of size, feet	Gauge heights in terms of mean, (28.03)	Difference from 1.000	Difference squared	Cube of Difference +	Cube of Difference —
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1937	1	0.68	57.1	2.037	+1.037	1.075	1.115	
1884	2	2.05	46.7	1.666	0.666	0.444	0.295	
1913	3	3.42	44.9	1.602	0.602	0.362	0.218	
1883	4	4.79	44.8	1.598	0.598	0.358	0.214	
1907	5	6.16	41.4	1.477	0.477	0.228	0.109	
1933	6	7.53	39.1	1.395	0.395	0.156	0.062	
1867	7	8.90	37.6	1.341	0.341	0.116	0.040	
1882	8	10.27	37.4	1.334	+0.334	0.112	0.037	
and so on—intermediate portion of Table not shown;								
1878	70	95.21	16.0	0.571	—0.429	0.184		0.079
1900	71	96.58	15.4	0.549	—0.451	0.203		0.092
1889	72	97.95	13.9	0.496	—0.504	0.254		0.128
1894	73	99.32	12.9	0.460	—0.540	0.292		0.157
Total			2,046.4	73.002		6.381	2.261	1.013

Average annual maximum gauge height $= \frac{2,046.4}{73} = 28.03$ feet.

Coefficient of Variation $= \sqrt{\frac{6.381}{73-1}} = 0.298$

Coefficient of Skew (computed) $= \frac{2.261-1.013}{(73-1)\ (0.298)^3} = 0.655$

Coefficient of Skew (adjusted)[2] $= 0.655 \times 1.117 = 0.732$

TABLE 2

Calculation of plotting points to draw a smooth curve (Curve A)

Coefficient of Skew = 0.73 ; Coefficient of Variation = 0.298 ; Mean Gauge Height = 28.03 ; Type III Probability Factors used.[1]

Plotting point, per cent, P	Type III Probability Factor	Product of Factor and Coef. of Variation	One plus product = limit in terms of mean height	Gauge height = previous column times mean hgt.
99.0	—1.79	—0.533	0.467	13.1
95.0	—1.40	—0.417	0.583	16.3
80.0	—0.86	—0.256	0.744	20.8
50.0	—0.12	—0.036	0.964	27.0
20.0	0.79	0.236	1.236	34.7
5.0	1.82	0.543	1.543	43.3
1.0	2.85	0.849	1.849	51.8
0.1	4.15	1.238	2.238	62.7
0.01	5.33	1.590	2.590	72.7

[1] *See Flood Flows, page 44.*
[2] *See Flood Flows, Table IV, page 189.*

A Fire-Proof Garage Built From Old Paving Brick

By M. J. McGRUDER
City Engineer, Lexington, Ky.

M. J. McGruder (left) and C. J. Tate discussing the project.

Using old paving brick, removed in reconstructing a street, Lexington, Ky., built a fireproof garage and warehouse with a total length of 378 ft. as a WPA project. The only wood used was in the doors and windows.

IN 1936 the State Highway Department, with Federal Aid, reconstructed a section of one of the main thoroughfares of Lexington, Ky. Due to the fact that the property owners were not required to pay any portion of the paving cost, the State and Federal government acquired all of the old paving brick and other salvage materials.

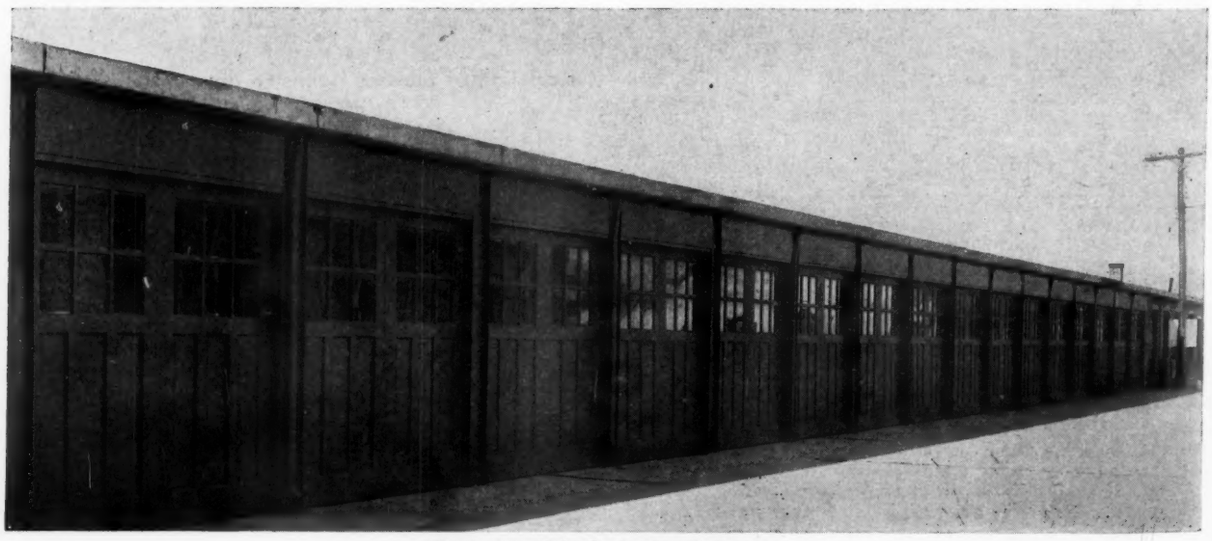
The bricks were given to the city with the stipulation that they were to be used on WPA projects. We conceived the idea of replacing with a fire-proof building, some of the out-moded structures at the city plant, which were fire traps and rat harbors, ill designed for present-day use, on which insurance premiums were very high. The city engineering force designed an "L" shaped building 378 feet in length measured along the rear wall, and 24 feet in width, consisting of a series of 9′ 3″ units except at the intersection of the two wings. The lengths of the wings, which are approximately at right angles, are 235′ 4″ and 142′ 10″ respectively, and no evidence of crawling has appeared.

The rear wall, which is along the property line, and the end walls and front consist of a 13-in brick wall on a concrete foundation of the same thickness. The foundation has a spread footing two feet wide and of variable depth. The top of the foundation is stepped up at several places to conform to the outside grade elevation.

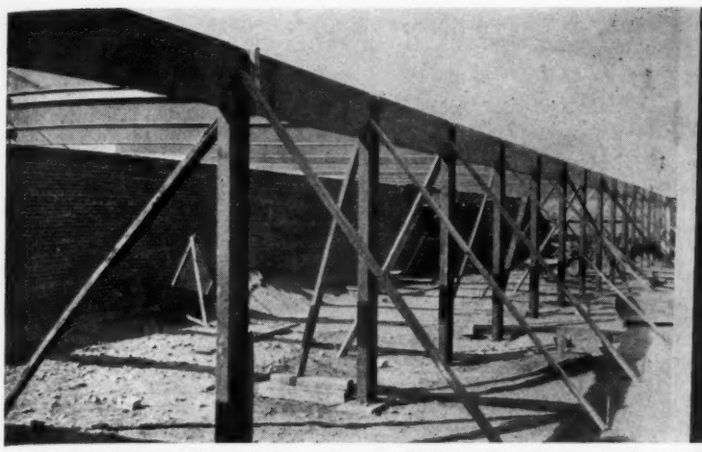
To reduce maintenance and other hazards, no windows were placed in the rear wall, and only one rear door, for the purpose of unloading cement.

Cement mortar with 10% in volume of lime was used for brick work. The bricks were reasonably clean and uniform of approximately 3″ x 9″ dimensions. The brick masons laid from 800 to 1200 bricks per day, each, and maintained a high quality of workmanship.

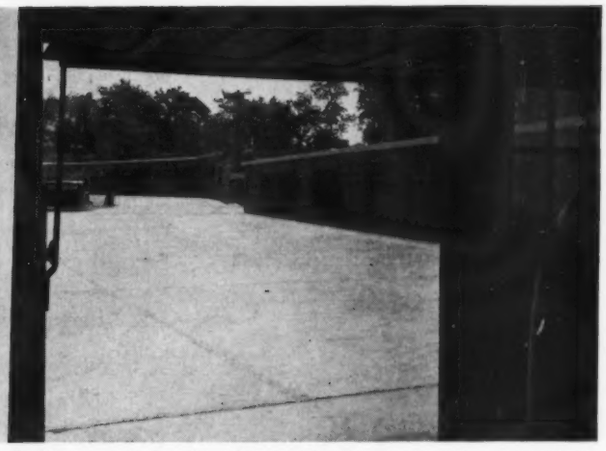
Five of the units, beginning at one end of the building, were enclosed, using a 13″ brick wall with doors and windows on the front side. These units are separated by 9″ brick walls and divided as follows: An office room 9′ 3″ wide, a cement room of like dimensions, and a warehouse consisting of three 9′ 3″ units. The room at the intersection of the wings is 29′ x 29′ with a 14′ wide "Over the Top Glazed Door" set at an angle of approximately 45° to the front walls of the ad-



West wing of the Lexington city garage



Steelwork for roof and front of garage. Brick wall in background



Looking east, showing door mechanism and south wing. WPA warehouse in background

jacent wings. All other units are uniform, with Over the Top Glazed Doors.

The door mechanism is bolted to the steel columns at either side of the doors and the over head tracks are fastened to the steel beams supporting the roof.

For the uniform units, 12″ 25 lb. steel I-beams on 9′ 3″ centers are supported by the rear wall on one end and on the other by 12″ 16.5 lb. steel columns, or by the front brick wall where such wall exists. Between the columns, steel lintels 16″ in depth extend from the roof to the top of the doors.

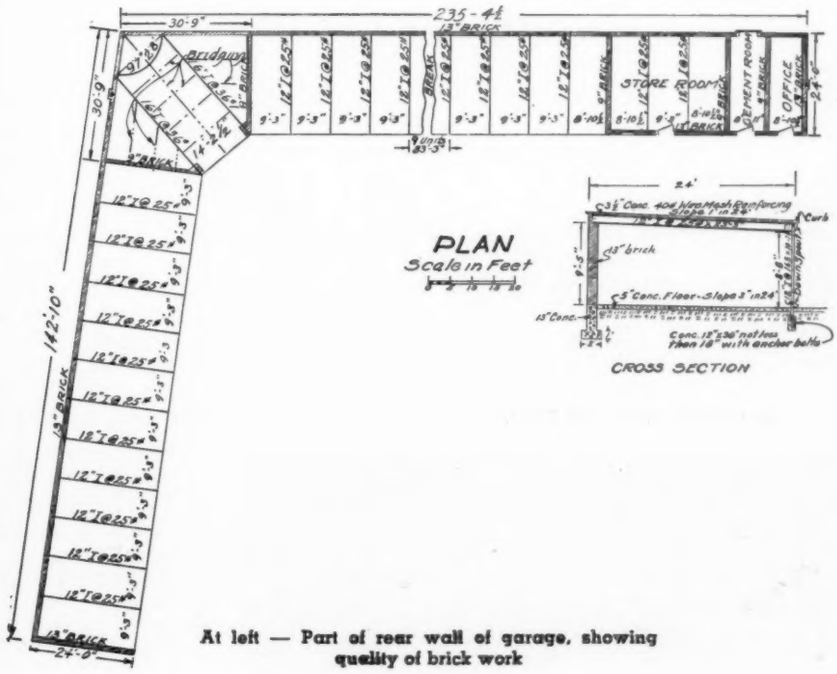
The roof consists of a 3½″ concrete slab of 1-2-3 mix with 40-pound wire mesh reinforcing, resting on the rear wall, I-beams and lintels, or on the front wall where such wall exists. The slab overhangs the rear wall 1½″, slopes downward toward the front at the rate of ½″ to the foot, and overhangs the front of the building 7 inches, where it has an 8-inch face, forming a curb which is 4 inches across the top. Two ⅜ inch smooth steel longitudinal reinforcing bars were placed in the curb, one near the top and one near the bottom.

The slab was placed with half-inch expansion joints over alternate beams. Openings for downspouts were placed at the columns entering each slab, rectangular downspouts being fastened to the web of the columns.

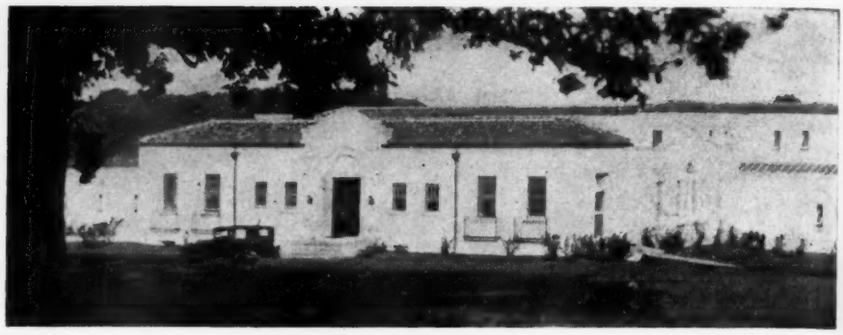
The forms for the under portion of the roof slab were made in sections which were easily placed and adjusted by use of Roos adjustible shores. The forms were lined with plywood, giving a smooth, pleasing appearance to the ceiling. The roof was painted with asphalt cut-back, filling any hair cracks in the slab and sealing the expansion joints.

The floor consists of a five-inch concrete slab with expansion joints along the rear wall and at 18′ 6″ centers transversely. The slab slopes downward 3″ toward the front and extends to a line one foot inside of the face of the building, at which point a six-inch reinforced concrete apron five feet wide slopes 2½ inches toward the concrete driveway in front of the building.

The doors and windows constitute the only wood portions of the structure.



At left — Part of rear wall of garage, showing quality of brick work



General view of main building of the Aurora plant.

How the Moisture Content of Slu

FOLLOWING the completion of a new final sedimentation tank at the Aurora, Ill., sewage treatment plant in 1937, digester operation became unsatisfactory. Walter A. Sperry, in charge of the plant, began an interesting study of the probable causes. He reported the results of his work at the conference last December of the Illinois Sewage Works Operators, and a summary was published in the February issue of the *Digester,* which is issued by the State Department of Health. The following information is based on the above mentioned summary.

Evidence of unsatisfactory operation included the presence of an excessive amount of solids in the supernatant liquor, and an apparent filling of the digesters faster than the digested sludge could be withdrawn to drying beds. Since this occurred, even though the digester tank volume should have been ample to handle all the sludge produced, Mr. Sperry went to his past records of operation to determine what differences, if any, could be found that might account for this occurrence. He tabulated sludge information, as follows:

Year	*Primary sludge pumping time (Min. per day)*	*% Solids in raw sludge*	*Wet sludge pumped (Cu. ft. per day)*
1931	180	6.3	954
1933	207	5.5	1110
1935	333	4.6	1464
1937	513	3.7	3210

These data show that there had been a gradual increase in the time the sludge pumps were operated each day with the result that the sludge pumped to the digesters became thinner all the while. The sludge pumping rate was 40 gallons per minute throughout the period. It will also be noted that the daily volume of wet sludge pumped to digesters increased as the sludge became thinner.

Mr. Sperry then began to study the effect of the thin raw sludge on the sludge content of the digesters and found that the digester sludge contained 9.4% solids in 1932 when a thick raw sludge was pumped while the digester sludge contained only 6.5% solids in 1937 during the time the raw sludge pumped was thin. Determination of the digester volume required for sludge at various percent solids values (from specific gravity studies), showed the following:

% Solids in sludge	*Digester volume for 1000 lb. dry solids*	*% Solids in sludge*	*Digester volume for 1000 lb. dry solids*
1%	1625 cu. ft.	7%	233 cu. ft.
2	813	8	203
3	542	9	189
4	407	10	170
5	325	15	118
6	271	20	89

This indicates that every 1000 pounds of dry solids in the digesters in 1937 occupied 32% more volume than the same weight occupied during 1932 digester operating conditions. In effect, the actual digestion capacity was reduced about one-third by pumping the thin raw sludge to the digesters.

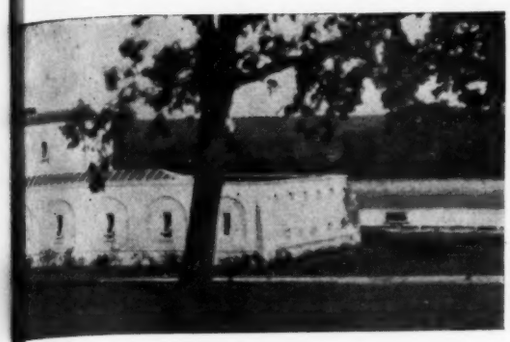
These facts led to modification of the raw sludge pumping schedule and the time of pumping was reduced to the absolute minimum needed to keep the primary tanks clean. Reduction of the sludge pumping time to 387 minutes per day during 1938 resulted in thickening of the raw sludge to 5.2% solids (from 3.7% in 1937) and a reduction in the volume of wet sludge pumped to 2,520 cubic feet per day (from 3,210 cubic feet per day in 1937).

The change in pumping procedure produced immediately an improvement in digester operation and the digester sludge concentrated from 4.9% solids in January, 1938 (requiring 336 cubic feet of digester volume per 1,000 pounds of dry solids) to 10.2% solids in September, 1938 (requiring only 180 cubic feet of digester volume per 1,000 pounds of dry solids).

The following procedures in raw sludge pumping are suggested by Mr. Sperry:

1. Endeavor to pump thick sludge (5% solids or more) if possible. A thick raw sludge results in dense sludge in the digester and greater storage capacity therein. Sludge of high percentage solids may be obtained by (a) reducing the pumping time to a minimum, (b) pumping at a low rate, as near 40 g.p.m. or below, if possible and (c) pump the minimum times per day necessary to get clean primary tanks and a reasonably fresh sludge.
2. Accurate measurement of raw sludge by a meter is to be desired. The volume pumped daily can be estimated by keeping a record of the time the pumps are operated and determining

Dorr Clarifier at Aurora Plant.



A digester that showed signs of overloading when it was not overloaded started Walter Sperry on investigations that resulted in valuable data on the effect on digestion of the moisture content of the sludge.

Sludge Affects Digestion

the capacity of the pump, if there is no meter. Where there is a raw sludge well, the sludge can be easily and accurately measured by computing the volume drawn to the well.

3. Laboratory determinations of percent solids on carefully taken sludge samples are invaluable for control.

The fact that digestion proceeds more rapidly at higher temperatures is brought out definitely by the following data:

Digestion temperature (F°)	*Cubic feet gas per pound volatile matter*
74	8.2
80	9.1
83	10.9
88	10.7
93	12.7

This shows that rate of digestion was 55% higher at 93° F. than at 73° F. Other interesting statements made in this connection were:

1. The digestion of one ton of dry solids produces about 16,000 cubic feet of gas, weighing about 0.5 ton.
2. The weight of the gas produced just about equals the weight of solids lost in digestion.
3. About 1,000 cubic feet of gas is produced from each 64.3 pounds of volatile matter destroyed during digestion.
4. About 100 pounds of water is produced in burning 1,000 cubic feet of gas.
5. The volume of gas produced varies each day according to the amount of sludge fed to the digester.
6. The gas produced at Aurora averages about 62% methane, 32% carbon dioxide, 3% hydrogen and 3% nitrogen. A reduction in methane content and corresponding increase in the percentage of carbon dioxide indicates tendency toward acid (unbalanced) conditions in the digester.

Grease skimmed from various plant units had formerly been incinerated and when it appeared desirable to send this to the digesters for greater convenience in handling and to increase gas production (sewage is pumped by gas engines at Aurora), Mr. Sperry made preliminary bottle experiments on digestion of grease with sludge.

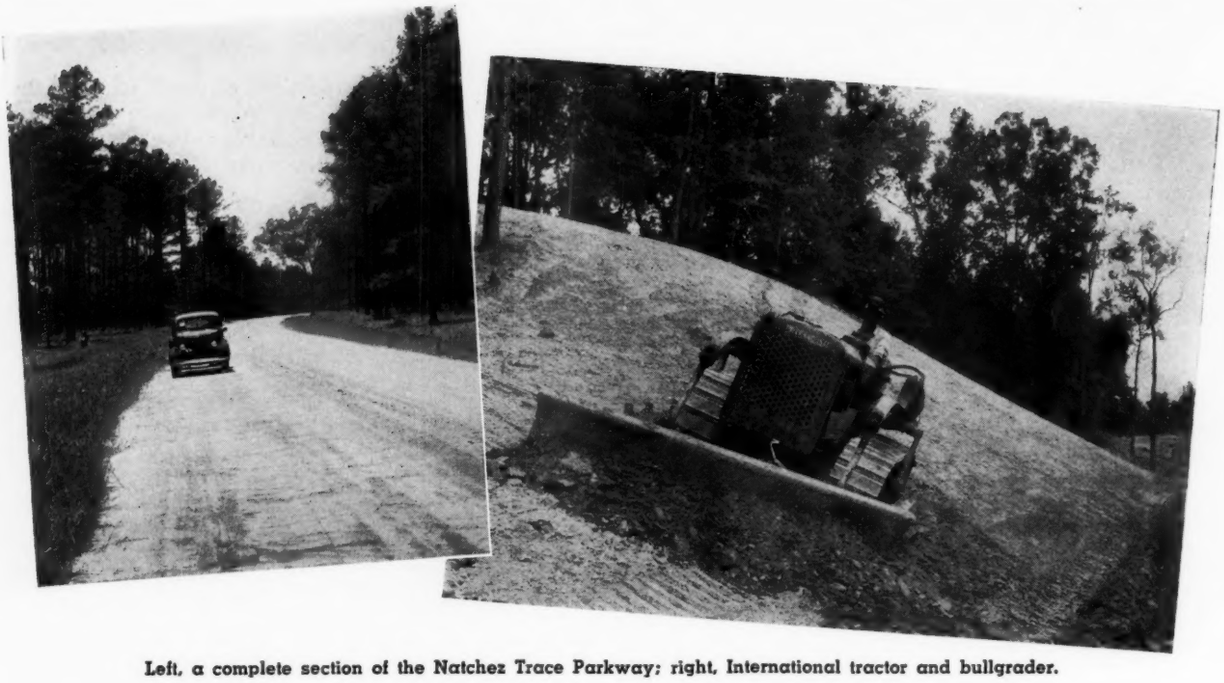
These studies indicated that satisfactory digestion could be expected with grease discharged to the digesters and that an increase in gas production and improved fuel value gas should result. These conclusions are now substantiated by actual plant operation.

From his work, Mr. Sperry has concluded that digester scum, consisting mostly of leaves, twigs, and material of similar composition, does not tend to accumulate. His observations are that scum digestion is very slow but that the scum depth decreases each time sludge is drawn. It appears that the scum layer has little, if any, effect on the release of gas, even when the scum layer is 4 to 5 feet thick.

Interior view of apparatus

The Aurora experience is ample proof, says the *Digester,* that a monthly inventory of digestion units (particularly those which are operating near to capacity), is of great value. A series of samples collected at one-foot depth intervals, upon which total solids, volatile solids, pH and specific gravity determinations are made, shows the varying conditions throughout the depth of the tank. Accurate computations of the pounds of total and volatile solids in the tank are also made possible by this procedure. These data tell the operator when and how much sludge can be drawn to the drying beds at any time without removing too much alkaline digesting or "seeding" sludge and destroying the balance between "feed" and "seed" in the digester.

When used with routine total and volatile solids data on samples of raw sludge, digested sludge and supernatant liquor and with volume measurements of raw sludge, digested sludge and gas, Mr. Sperry is able to balance the pounds of solids in the tank at the beginning of the month plus the pounds added during the month against the pounds remaining at the end of the month plus the pounds of volatile matter destroyed plus the pounds of solids removed in supernatant and to drying beds, with remarkable accuracy.



Left, a complete section of the Natchez Trace Parkway; right, International tractor and bullgrader.

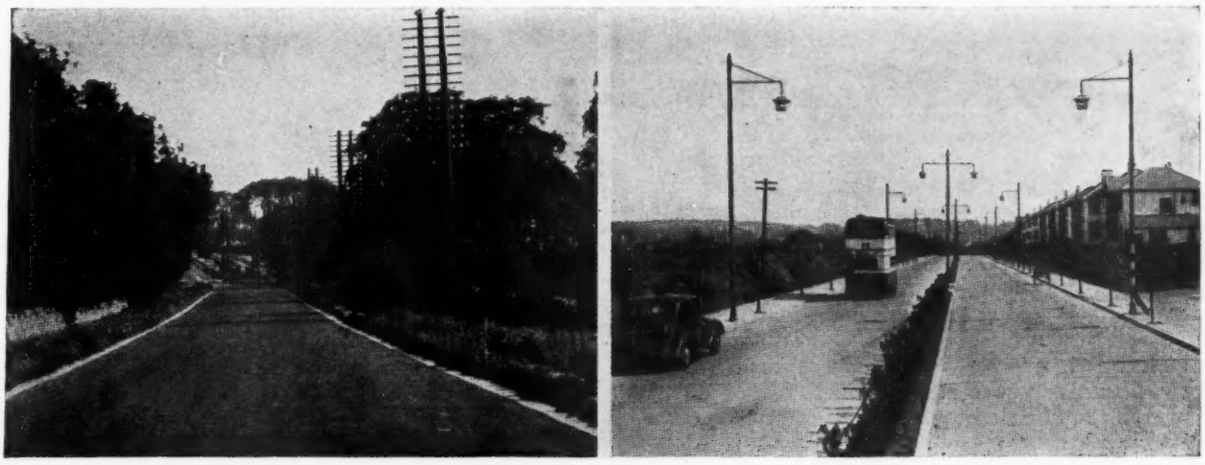
A Highway Built for Pleasure Use Only

FOR 455 miles, along the old Natchez Trace, a modern highway is being built under the jurisdiction of the National Park Service of the Department of the Interior, from Natchez, Miss., to Nashville, Tenn. Supervision of construction is under the Bureau of Public Roads. Right-of-way along the entire Natchez Trace Parkway varies in width from a minimum of 500 feet to 1,200 feet, and additional widths are under easement control. This means that all of the land actually within sight of the roadway will be supervised by the National Park Service and encroachments can and will be prevented.

The parkway is designed for pleasure only; there will be no hot-dog stands; no roadside advertising; and none of the painful appearing structures that mar so many of our modern roadsides. Flat curves and long sight distances will prevail. Plans have been made for controlling erosion. Slopes in cuts and fills will be smoothed and curved to fit the adjoining landscapes, and will be sodded or seeded, thus preventing construction scars and reducing after maintenance. With slight deviations, necessary to meet modern construction requirements, the new highway will follow the route of the old trail. The road will be graded to a width of 34 feet and the paved portion will be 22 feet wide.

On the construction, many types of modern equipment are being used. Shown herewith are an elevating grader loading into trucks; a dragline loading into trucks; and bulldozers. Considerable excavation is required. On the Hodgins-Adams contract, Section 3-0, 12.8 miles in length, the grading contract called for 550,000 cubic yards of excavation. On the Pigford Bros. & Shuptrine Construction Co. contract, Section 3-W, 12 miles long, excavation amounted to about 1,000,000 cubic yards.

Views of construction work along the Parkway. (Courtesy International Harvester Co.)



Left, country road in England; right, Crownhill Road., City of Plymouth, England. Note vehicles keep to left.

Reports on English Road Research

THE report for 1937-38 of the Experimental Work on Highways (Technical) Committee, has been published by the Ministry of Transport, Roads Department, London, as a 166-page book with numerous tables. This sells for 2s. 6d (about 60c). This report reviews the full-scale experimental work carried out by the Ministry of Transport during the year 1937-38. The introductory chapter contains a general survey of the year's work, the remaining chapters dealing respectively with concrete, cement-bound macadam, tar and bituminous surfacings, thin surfacing coats, surface dressing and footpaths in rural areas. The various aspects of road design, construction and maintenance included in the Committee's program are summarised in a table, with reference to the experiments.

Features of special interest in the year's work include: a comparison in respect of quality and cost, between hand-consolidated concrete and similar concrete placed and finished by machinery: an investigation of the cost and effectiveness of reinforcement in road concrete; measurements of the deflection at the joints of concrete slabs under traffic; observations on the visibility at night of various types of surface dressing, and of the durability of thin surfacing coats, both in rural and urban districts. The results of several series of skidding tests, extending in many cases over some years, afford valuable comparative data regarding the durability and non-skid quality of various types of road surfacings, and the relative merits of different surface textures, and it has been possible to correlate certain of these results with those of profilometer measurements.

The report of the Road Research Board, with the report of the Director of Road Research for the year ended March 31st, 1938, is also available from H.M. Stationery Office for 4s. 0d (about 96). The work described was carried out at the Road Research Laboratory, Harmondsworth, Middlesex.

The measurement of impact forces between a vehicle and the road has led to important results during the year. It now appears possible, even in the complicated case of a 6-wheeled lorry, to predict, from a knowledge of surface irregularities of a road and the vehicle characteristics what forces will be imposed on a road. Impact measurements have been checked by high speed ciné pictures of wheel movements and tire distortions during the passage of vehicles over an irregular surface. Records were made on a private car travelling over an obstacle at 22.5 and 50 miles per hour, and of a lorry at 15 and 40 miles an hour, the pictures being taken at a rate of 1,000 to 2,000 per second.

Skidding tests are to be made on road surfaces at speeds up to 75 miles per hour by an apparatus towed behind a high-speed car. The technique of road texture printing, in which a portion of the road surface is inked and a print taken from it, has been improved. In its present form, this method has shown itself very useful in recording surface condition and surface changes. A method has been developed for improving the skidding resistance of concrete surfaces, which through faulty design or workmanship, are undesirably smooth. This consists in treating the surface with acid. Tests have shown that marked improvement is thus obtained and the cost is likely to be considerably less than that of resurfacing.

Investigations on the pressure exerted by pneumatic tires on road surfaces have also developed in a way which has led to a better understanding of skidding phenomena. It has been found that local pressures on small projections, such as the individual stones in a surface dressing, may amount to many hundreds of pounds per square inch, and that the intensity of pressure depends to a marked extent upon temperature. It is known that large seasonal variations occur in the skidding characteristics of road surfaces, and it now seems probable that changes in the physical properties of tires may be responsible for a part of these variations.

Road machines enable road conditions to be approximately reproduced and duplicate surfacings to be subjected to accelerated tests. In the largest of the three machines in use at the laboratory a full-sized

Pressures exerted by pneumatic tires on road surfaces; skidding tests at speeds up to 75 mph.; measuring wet and dry road lime by road clocks; and bituminous mixtures have been investigated by English research bodies. This is a summary of results reported.

lorry is driven electrically at speeds up to 40 miles an hour round a circular track 110 ft. in diameter. Another small machine is now under construction in which conditions of temperature and moisture met with on roads can be reproduced artificially. The value of road machine tests depends entirely on the degree to which the relation between such tests and tests on the roads themselves is known.

In comparing road machine tests of various road surfacings with tests on the open road a knowledge of traffic conditions is required. Special apparatus has been devised which automatically counts throughout the 24 hours the vehicles passing in both directions along the road. The traffic in passing over the rubber traffic pads, inserted in the road, of the type usually used for actuating traffic lights, closes relays, which in turn operate a number of electric counters. It is not only necessary to know the volume of the traffic, but how it is distributed across the width of the road. This is being determined by a "camera obscura" placed in a hut alongside the road. In this hut, observers see a view of the road optically projected on to a white disc on which lines are drawn parallel to the curb. Thus without making any lines on the road itself, which might affect the normal flow of traffic, the sections of the road used by various types of traffic can be observed.

What is called a wet road clock, depending on the changes of electrical resistance between metal strips laid in the road, records the length of time that a road is wet or dry.

Earthwork and Foundations

Increased attention has been paid to the study of earthworks and foundations in relation to roads. The laboratory is endeavouring to collect accurate information on the change in volume when soil is excavated, deposited and compacted as filling. For measuring the temperature inside bituminous road carpets during laying and rolling an electrical thermometer is used with which a thermojunction is formed at the point of a hypodermic needle.

Among investigations brought to the point of full-scale testing is work on bituminous surfacing mixtures. The simple forms of test devised for bituminous materials have been applied to the determination of the most suitable binder contents for different types of aggregate, filler and binder. The measurement of the bulk density of fillers when suspended in benzene has shown that a definite relation exists between this property and the optimum proportion of filler to tar. The addition of small percentages of chlorinated rubber to tar has been shown to be accompanied by marked increase in viscosity and it extends the temperature range over which the material remains plastic.

These reports have been adapted from fuller data in Road Abstracts. Illustrations are through the courtesy Wm. Prestwich & Sons, Ltd., and British Reinforced Concrete Engrg. Co.

Funds to Meet Road Contract Required

The West Virginia Supreme Court of Appeals holds, (Love v. New River, etc., Coal Co., 193 S. E. 59) that the test of whether a county highway construction contract was legal under a state statute because it did not involve an expenditure in excess of funds legally at the disposal of the county court, was whether the amount of money available for lawful disposal by the court at the time of making the contract was sufficient to meet the contract, and not whether the amount available on completion of the contract was sufficient.

Folwell Elected Honorary Member of A.P.W.A.

The American Public Works Association has elected A. Prescott Folwell, Sc.D., Editor of *Public Works*, to honorary membership, on the unanimous recommendationn of the Board of Directors, "in recognition of the high level of his contributions to the advancement of public works engineering and his long and valued service to the Association"; (he being one of three so honored.)

Mr. Folwell 37 years ago became a member of the American Society of Municipal Improvements (which in 1937 consolidated with the International Association of Public Works Officials to form the American Public Works Association), was its eleventh president, was for seven years its secretary, and during his entire membership has been a member of one or more of its committees, most of the time as chairman of at least one of them.

He has practiced engineering for over fifty years, almost exclusively in the municipal field; is the author of "Sewerage" (now in its eleventh edition), "Water Works Engineering" and other engineering books; was for ten years Professor of Municipal Engineering at Lafayette College, and has been editor of *Public Works* for the past thirty-two years.

A New Type of Sewer Form

A new method of constructing twin concrete sewers requiring special steel concrete forms and individual wheeled carriers for the form sections, is being applied in the construction of a 3,400 foot trunk sewer to carry storm water and sanitary sewage along the east side of the World's Fair area. Blaw-Knox Company, Pittsburgh, Pa., working with the contractors, Tully & Di Napoli, of New York, designed the forms and devised the operating methods.

The sewer is divided into an upper and lower barrel. It was the construction of the lower barrel, measuring 22 feet wide by 8½ feet high, that required the development of new equipment and handling methods.

To get the utmost value out of the steel forms, it was necessary to "strike" the forms as soon as possible after pouring. In order to do this it was found to be necessary to erect a row of supporting shores on the vertical center line of the sewer to support the weight of the arch and floor of the upper barrel, and allow these shores to remain in place several days after the removal of the concrete forms. To permit this, the forms were fabricated in half sections and individual carriers provided for the moving of each section.

In constructing the carriers it was necessary to make provision for stabilization of the weight of the form sections by counterweighting the travelers, since they were forced to carry the forms in an unbalanced fashion, the vertical or side portion of a form hanging outside the traveler wheels. Perfect alignment and easy collapse of the form halves was accomplished by mounting the section on the traveler in such a manner that the operation of four members adjusted or collapsed the section. Anchor jaws on the side portion of the forms grasp a turnbuckle rod and a steamboat ratchet, both of which are pivotally fastened to the traveler. Operation of the ratchet similarly operated the top slab of the form, and was so mounted that its pivotal end caused the form to swing toward the shoring into the proper position on the traveler when the forms were collapsed.

The Editor's Page

The Highway Industry Needs Modern Tools

Any industry that spends three billion dollars a year ought to be run in the most efficient fashion. Highway construction and maintenance—state, county, city and town— ordinarily account for about this sum annually. As a comparison, the total wholesale value of all automobiles and trucks sold in the United States last year was a little more than one-half this sum.

But what a difference in equipment! The automobile industry realizes that the most modern equipment is necessary in order to build up-to-date cars that will satisfy the demands of purchasers. Tools that are comparatively new are junked if other tools are available that will do better work or do the same work at less cost. One of the largest automobile manufacturers has said that modern equipment costs more not to have.

In highway construction and maintenance, these same facts are just as true as they are in manufacturing. A modern maintainer may do twice as much work; it may do work so much better that the finished road will last twice as long; but until the old maintainer has been worn out—and generally completely worn out—it is unusual to buy a new one. A modern roller will do many times more work than a steam roller of the vintage of 1910, and better work too. Snow plows and trucks are too often held for "one more winter's service" before replacement, with the result that a heavy storm ties up the community until new equipment can be procured.

The ingenuity with which engineers and superintendents contrive to make old equipment continue to perform—after a fashion—excites our admiration. But if these engineers and superintendents would use half as much ingenuity in wangling an appropriation for new and modern equipment, the taxpayers would fare a lot better in the end.

Engineers Are Needed on This Job

With the disappearance of winter's snow banks and the appearance of signs of spring, summer camps, summer hotels, resorts, cottages, and all sorts of similar establishments begin to get attention of a sort. Mostly this consists of cleaning up, repairing screens and buildings, and doing other work to get ready for the coming season.

The sanitary provisions that are needed in every one of these places are honored about as often by complete forgetfulness as by observance, despite the efforts of health officials. Improper waste disposal and doubtful water supplies are altogether too common.

While, as some one has said, "innocence in a water supply is better than repentance," we believe chlorination, at least, should be required in every water supply; and similarly that an adequate treatment device should be placed in the lower end of every sewer.

These conditions should be remedied at once and the local engineers are the men who ought to do this work. They are familiar with local conditions; they are generally able and thorough; they will be doing the community (and themselves as well) a good turn if they investigate sanitary conditions in their vicinity, finding where they are unsafe, and will doubtless have the endorsement and aid of their local and state health boards in securing the remedying of such conditions.

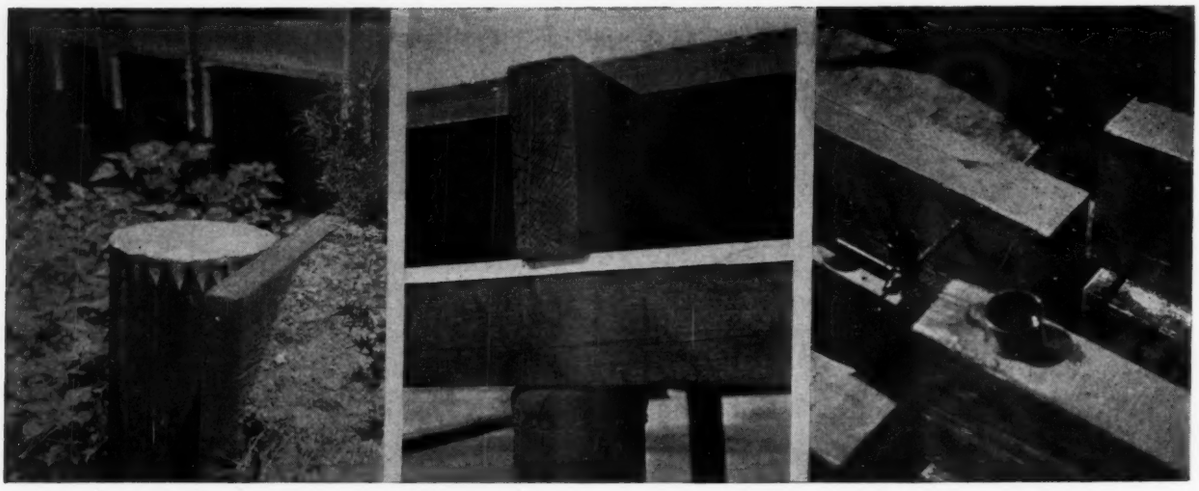
The People Recognize Ability and Faithfulness

Out in Ridgewood, N. J., the whole community turned out recently to celebrate the completion of the first 25 years of J. Arthur Carr's superintendency of that city's water department. There is a lot of food for thought in such an event, both for other water superintendents and for those who govern our cities and villages.

First, it would not have been possible for Mr. Carr to attain and hold this high esteem of his community if he were not well-trained, able, and efficient. These qualities do not merely descend on any man. The basic needs are study, both in the office and in the field, and the development of judgment and experience.

If the governing officials of Ridgewood had looked upon the water works department as a means of repaying political favors, the Village would not have enjoyed this continued capable and efficient administration of their water works department over a period of 25 years; they would have suffered both as consumers and as taxpayers. It is no small responsibility to manage a utility in which three-quarters of a million dollars of the public's money is invested, and it is a blessing to the taxpayers and the water users when such a utility is well-managed.

It may sound like preaching, which we dislike, but the lesson in this seems to be, for the superintendent, that he cannot stand still; he must use every possible effort to learn more about his business and about how to administer it; and he must popularize the water department with the public. Having done this, he must rely on enlightened public officials and on popular sentiment to prevent politics from interfering.



Left, pile cutoff protection; Center, another example of good protection; Right, device for treating bolt holes.

Maintenance of Treated Timber Highway Bridges

By W. A. STACEY

Engineer, Service Bureau, American Wood-Preservers' Association

THE future maintenance requirements of any new treated timber highway bridge are, barring the unusual, pretty generally fixed at the time of its construction. The maintenance thereon is going to be dependent upon the skill with which it is designed, the selection and the treatment of the timbers that enter into it, and the care in construction.

When creosote is injected into timber in conformity with standard pressure processes and in the amounts commonly specified for highway bridge material, namely, about 12 lbs. per cubic foot, it makes such timbers and piles immune from decay for many years even against the severest exposure. To realize the full value of the treatment, however, these materials should not be subjected to field cuts and framing that expose untreated wood in the heart of the pieces and thereafter be placed in the structure unprotected. Whenever possible, the timbers should be framed and bored before treatment. It is usually a matter of economy to do so, as most treating plants are equipped to do such framing work at less cost than it can be done by hand in the field. The framing of members for a carefully designed bridge is exceedingly simple. Many structures have been built entirely of precut and prebored pieces.

It is not always practicable, of course, to frame all members before treatment. Skillful design, however, will reduce the necessary field framing to the cutting off of piles and the boring of a few bolt holes which can not be correctly located before the bents are driven. In the case of pile cut-offs, only the end grain of the wood is exposed and this takes up preservative readily. Hot creosote and sealing compound, applied in the field, insure good protection if the cut-offs are thereafter effectively roofed to exclude moisture. Bolt holes that must be made in the field should also be swabbed with hot creosote and sealing compound or, preferably, treated under pressure with a bolt hole treater.

Longitudinal rail members frequently are not treated with creosote because the engineer desires to paint them white to afford better visibility and secure a pleasing color contrast. These rails, of course, can be easily removed and replaced. If, however, the location is such that untreated rails have a comparatively short life, they should be treated with zinc chloride. So treated, wood can be painted as effectively as untreated.

The maintenance of treated timber bridges of good design, treatment and construction may therefore be summarized as comprising the following items, all of which can usually be attended to for a very small cost at intervals of 4 or 5 years:

1. Paint rails to restore visibility.
2. Tighten bolts at time of first repainting in order to take up any slack induced by final seasoning out of large timbers.
3. Check the condition of field cut-offs and, if exposed, occasionally re-treat with preservative and sealing compound. See that pile cut-off covers remain effective.

The sealing compound referred to above is usually made by mixing one part of creosote with two parts of tar or pitch. Pile cut-off covers are generally of copper, zinc or galvanized iron, or very heavy roofing, or several layers of canvas saturated with sealing compound.

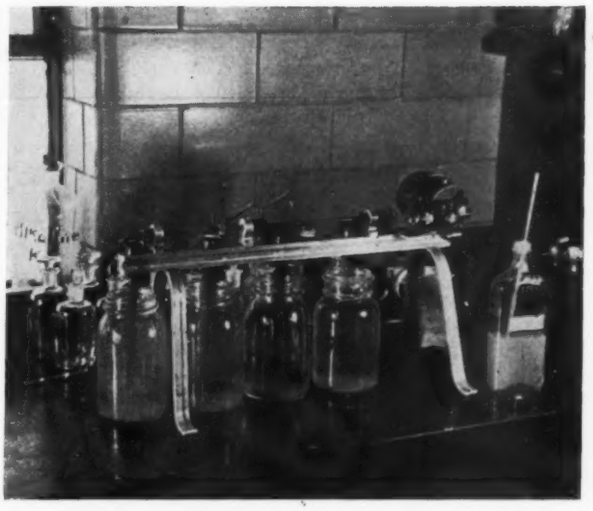
To obtain the best results, all timber highway bridge floors should be protected from traffic abrasion by an approved wearing surface. The most effective support for any such surface will be afforded by a continuous or tight floor such as laminated strips, heavy shiplap, tongue and groove, or splined plank. A wide variety of wearing surfaces has been used for this purpose, including earth, sand-clay, gravel, bituminous mats and concrete. The lowest maintenance costs on such bridge surfaces are generally obtained by placing on the treated wood bridge the same kind of surface as exists on the adjoining highway so that the bridge and road surfaces may be maintained together as a continuous unit.

Laboratory and Plant Trials of Chemical Coagulation

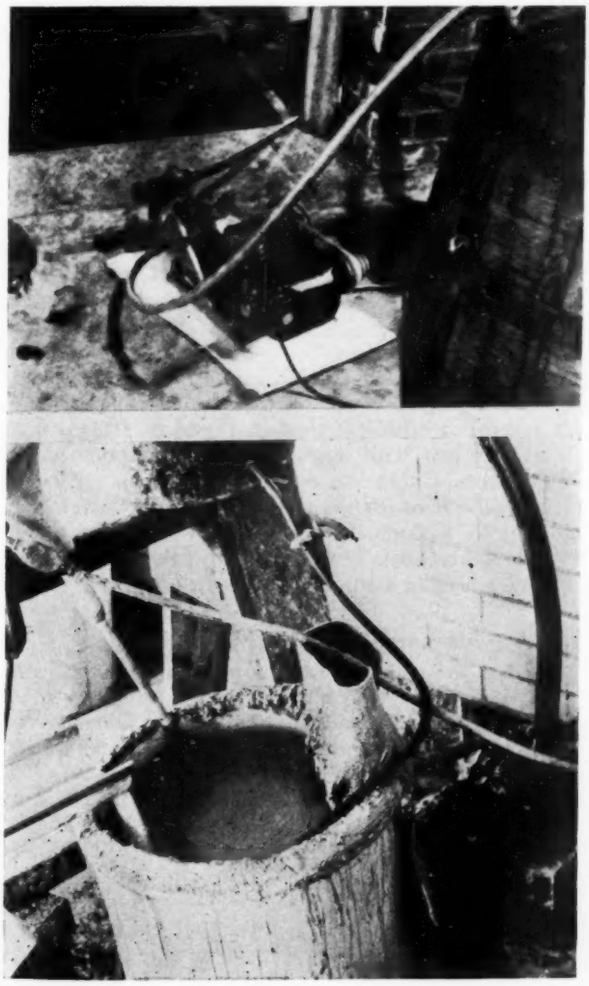
By FRANCIS K. BURR

DURING the past few years there has been an increased interest in chemical coagulation, for both water and sewage. In many plants all over the country, especially in sewage treatment, experiments are being made to determine how existing processes can be improved or replaced by means of chemical treatment. In this article are outlined the various steps in the procedure. Although particular attention is paid to the use of Ferrisul, which is the trade name for a ferric sulphate, the information given is generally applicable to any coagulant.

Laboratory studies do not always give the complete answer to a problem; in fact, certain studies can be made only on a plant scale. Laboratory work is therefore limited by the degree to which plant conditions can be duplicated. And even when plant conditions have been copied to the extreme, the variation obtained in results of tests made on plant scale may be surprising or even perturbing. Yet the laboratory is the logical starting point for the accumulation of information and experience necessary to apply any process successfully to plant scale operation.



A multiple stirrer is needed for laboratory work



Some of the plant scale apparatus; above a Proportioneers unit; below a "thrown-together" makeshift that worked

Laboratory tests begin with the making of stock solutions. Information on procedures in making these are given in detail on pages 64 and 66 of the June, 1937, issue of PUBLIC WORKS and on pages 30 and 31 of the April, 1938, issue. These cover amounts of chemical and method of making solutions for liter or quart samples, and for dosages in parts per million or grains per gallon.

In using Ferrisul, hot water and not too much of it should be used for dissolving. Stock solutions for jar tests should be diluted not lower than 1% of strength if they are to be kept for any length of time. Weaker solutions hydrolyze or break down, thereby precipitating ferric floc before it has had a chance to do its intended job.

Other solutions that will be needed will include lime, soda ash and acid for adjusting pH, and solutions of such other coagulants as may also be tested. A stirring device is almost a necessity. Having four or six jars not only cuts down materially the time required for testing, but allows direct comparisons of different dosages.

Having collected the water or sewage samples and placed them in the containers under the multi-place stirrer, the study is under way. After the addition of the coagulating chemicals, the following should be noted: Rate of floc formation, the size of the floc and the clarity of the liquid after coagulation. Now in the case of a demonstration, begins the round of questions on the part of the potential user. The most popular

question is, "What is the optimum pH?" In addition to being most popular, it is the hardest to answer. Flocs produced by ferric sulphate have been found to be effective all the way from pH 3.5 up. This does not mean that any particular water or sewage can be "flocced" anywhere in that range with excellent results. It indicates only that there is a wide range for floc formation, with the optimum pH to be found only after experimentation.

In manganese removal, a high pH is required, and with ferric sulphate this can be removed in the range pH 8.5-9.5. This permits removal near the stability point of the water treated, which may eliminate pH correction in the clearwell. On the other hand, color removal reactions take place best on the acid side, sometimes as low as pH 3.8. Coagulation of turbid water may take place best in the neutral or alkaline zone. Softening is usually accomplished in the vicinity of 10.0. Coagulation of sewage or industrial waste may have to be carried on anywhere from 6.0 to 9.5, or even higher, because adjustment of a highly buffered waste may be too costly.

For these reasons, it will be understood that the answer to the question "what pH" must be peppered with qualifications.

In judging the qualifications of the coagulants, there are other things to be considered. This brings up the question of how to judge the results. This may be on the basis of the fastest settling floc, the clearest supernatant and the lowest cost for water or sewage coagulation; and in color removal, on the basis of the required final color at the lowest cost.

In using ferrous salts, some operators fear that they will have excess residual iron in the filtered water, which will show up in the distribution system in the form of red water. This will occur with ferrous salts that have a narrow coagulation range when the pH control gets out of hand. With ferric salts it can happen only when the raw water contains ferrous iron in excessive amounts and coagulation on the acid side fails to remove it. The prescription in such cases is prechlorination, pre-aeration or treatment on the alkaline side, or possibly a combination of these.

Now for the plant-scale trial. The first problem to be settled is the equipment required to feed anhydrous ferric sulphate. Whether dry feed or liquid feeding is to be used, depends largely on the size of the plant. In plants feeding less than 10 or 15 pounds of coagulant per hour, solution feed is indicated.

The main factors influencing the design of ferric sulphate feeding equipment are the solubility characteristics and the corrosiveness of ferric sulphate solutions. Materials that may be used in contact with the solution are lead, rubber, 18-8 stainless steel (Alleghany metal), duriron and earthenware. The dissolving of the ferric sulphate on a plant scale is easily accomplished if the ratio of water to the coagulant is kept in the neighborhood of 2:1 by weight. It has a heat of solution of 260 BTU per pound and in this limited ratio an appreciable temperature rise will occur, which increases greatly the rate of dissolving. During the hydration process, the material passes through a transitional phase in which it is gummy. To prevent caking, agitation must be provided to keep the material in suspension until completely dissolved. This sounds more difficult than it really is. In practice, ferric sulphate is fed from any standard dry feeder into a lead lined dissolving pot equipped with a stainless steel agitator and a water measuring device. Capacity must be such as to allow a 30-minute detention period. A 12-gallon pot will handle about 100 pounds per hour. Several manufacturers provide excellent apparatus for this purpose.

When the trial is to be only a short one, such orthodox equipment is not necessary. "Informal" equipment, set up for feeding, has been designed cooperatively by the plant engineer and the writer, using materials nearest at hand, such as salvaged tin cans, earthenware crocks, resulting in monstrosities that might be called an engineer's nightmare, but which worked.

During plant trials, the same tests are made as during laboratory tests—perhaps even more, as checks are made on every phase of treatment. The length of the trial is dependent on the time required to estimate fairly the value of the coagulant. A few days, a week, or a month may be needed. Longer periods are required to determine effects of iron salts on sludge digestion where hydrogen sulphide is to be suppressed with the hope of more active digestion.

Evaluation of the test should cover, in addition to the costs of coagulant and the appearance of the effluent, such factors as odor removal in sewage treatment, length of filter runs in water plants and lowered requirements for other chemicals.

The type of work described in this paper has been carried on in many water and sewage plants. It has been made possible primarily through the interest of the plant engineers and superintendents, who are extremely research conscious and who desire to give a thorough trial to any material that promises better results at their plant. It is this cooperative spirit on the part of everyone concerned that is contributing so materially to the growth and progress of knowledge in the art or science of water and sewage treatment.

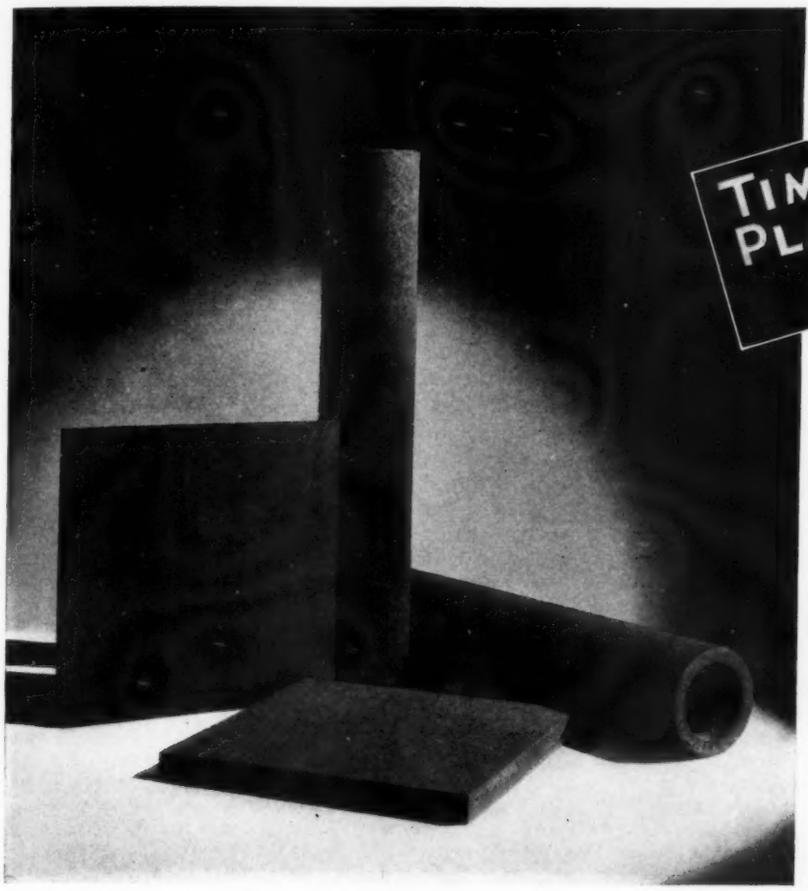
Permanent, Colored Asphalt Road Markers

Permanent colored guide lines for asphalt highways and better-quality asphaltic paints are among the first uses found for a new asphalt product which, until recently, could be produced only from petroleum found in an Egyptian oil field. This latest development of the petroleum technologist, discovered in a laboratory accident, is an asphalt virtually without pigment coloration. Because of this unique quality, it permanently can be dyed any desired color. Used without dye, it for the first time provides a practically stainless asphalt.

Several stretches of asphalt highway already have been marked with highly-visible alumnium-colored guide lines of this new material. The lines will last as long as the road surface itself, it is believed, thus eliminating the periodical application of painted lines. Paint manufacturers also have found this new asphalt highly useful, since it assimilates colors so readily.

Allotments of 16,700 PWA Projects

Up to the end of 1938, more than 37,000 requests had been made by communities for projects to cost more than 12 billion dollars. Of these, 16,700 have been allotted. Of those allotted, 2,421 were for water systems, estimated to cost $310,628,064; 1,525 were for sewerage, estimated to cost $459,684,385; 610 were for roads and highways estimated to cost $293,793,004; 382 were for bridges and viaducts estimated at $222,959,467. Schools accounted for 6,459 allotments, costing $933,224,657. Other allotments include hospitals, institutions, colleges, courthouses, city halls, flood control, water power and reclamation. These are exclusive of strictly Federal projects such as Fort Peck, Grand Coulee and Bonneville dams and the All-American canal.



TIME-TESTED PLATES AND TUBES *for Activated Sludge Plants*

NORTON POROUS MEDIUMS

ALUNDUM (FUSED ALUMINA) Plates and Tubes for the diffusion of air and gases and for filtering have met the tests of time in sewage purification, water filtration and commercial chemical processes. They have been relied upon since 1925.

These Norton Porous Mediums have contributed to the efficient operation of many plants in the United States and abroad and are included in all up-to-date specifcations for new plants.

NORTON COMPANY, WORCESTER, MASS.

New York Cleveland Chicago

R-615

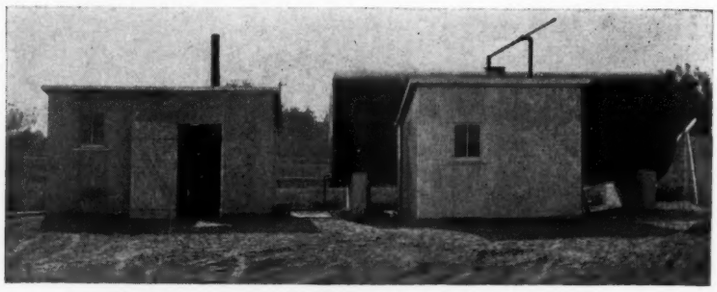
NORTON POROUS MEDIUMS

How to Maintain Highways and Streets

Prepared by

W. A. Hardenbergh and Consulting Staff

This is the fourth in a series of articles covering details of maintaining highways and streets. The May article will consider maintenance methods for macadam, bituminous, brick and concrete surfaces.



Asphalt storage tank, heating plant and pump house, Nebraska Dep't. of Roads and Irrigation

Handling and Storing Materials

Some kinds of maintenance work require only a small amount of materials, as patching, and the problems of supplying essential amounts as needed is not a great one. Other kinds of work, as surface treatment, require considerable material not easily stored; therefore, organization and advance planning are essential, if the work is to be carried on without costly and embarrassing delays. A gang of twenty men, sitting in the shade, while a lone distributor hauls bituminous material for 15 or 20 miles, is an invitation to criticism of a kind that is hard to meet. To break off a job that is three-quarters finished, because no more aggregate is at hand, requiring another start a few days later, is evidence—in most cases—of poor management.

In such work as re-surfacing with road mix, a considerable quantity of aggregate must be hauled, and this must be delivered on the road, in the proper sizes or grades, as needed. There is some leeway in such work, but not much. The problem of loading the trucks quickly so as to avoid having them stand idle, either in line, or to avoid undue loss of time while loading (because truck costs run on all of the time) is an important one.

Materials Needed in Bulk.—The two most common materials needed in bulk, will be bituminous materials, tar, asphalt, emulsion, etc.; and aggregate.

Bituminous Materials.—State highway departments, large cities, and many counties have established storage tanks for bituminous materials at railroad sidings. These tanks usually hold 10,000 gallons or more, and are of permanent construction—steel or concrete on firm foundations. Usually they are mounted high enough so that distributors, barrels or tank wagons can be filled by gravity. A pump and bituminous booster type heater is necessary equipment for unloading cars into the tank.

Cars for bituminous materials hold 6,000 to 10,000 gallons. Insulated cars are available, so that material can be delivered hot. For handling to storage the extra charge, though small, is not justified; but where the tar or asphalt is to be delivered into distributors for immediate application, this may be well worth while—particularly with the heavier grades. Insulated cars will lose about 20° per 24 hours, at normal summer temperatures.

Bituminous material is loaded hot into cars to make handling easier, and such heating increases the bulk. States usually make a correction for the temperature on large purchases, but for smaller jobs this is not of much importance and is frequently or generally disregarded. When material is purchased applied, as mentioned in the next paragraph, the pay gallon is usually measured at the temperature of application.

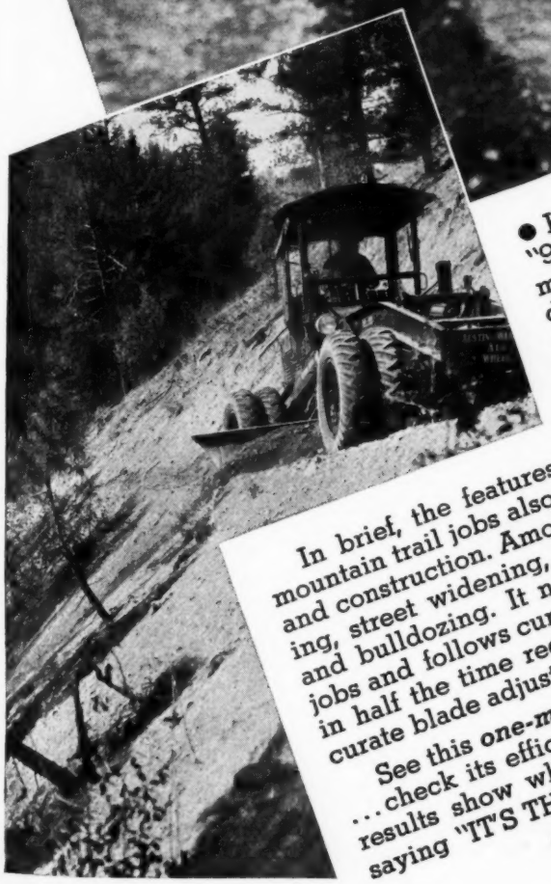
A number of the manufacturers of bituminous materials maintain large fleets of distributors, and also bulk storage at many points, so that they are equipped to deliver bituminous material direct to the road on almost any desired prearranged schedule. This is often the best means of solving the problem.

Where much bituminous material is used, storage tanks may be located at several points in a county, and material hauled during the off-season from railroad sidings. Such tanks are usually kept filled at all times. Equipment necessary for transfer and hauling would include a pump and heater and one or more supply tanks. These may be either of the trailer type, or of the type that can be mounted on or dismounted from a truck chassis. For economy, use distributors only for maintaining heat and applying; less costly equipment is available for heating and pumping.

Aggregate.—With aggregate, much the same problem exists as with bituminous materials. It must be delivered at the required spot at the proper time and in the correct sizes, in order not to delay the work. For instance, sufficient aggregate should be stored for winter and early spring patching, in case quarries do not operate in the winter. Whether it is shipped in, or manufactured at a local plant, is not important. Nor is it important that storage is possible in piles. Small piles along the road mean that hand work must be used. Large piles require careful management in two ways: 1. In placing in piles, the aggregate must not be built up as a cone, because the larger particles

Clearing out a ditch with a tractor and grader

THE MOUNTAIN TRAIL FAVORITE "GOES TO TOWN"



● Here are a few of the reasons why the A-W "99" Motor Grader really "goes to town" for municipal street superintendents. Its four-wheel drive and steer provide so much extra traction, driving power and maneuverability that, *single handed*, it economically cleans up a variety of construction and maintenance jobs that ordinarily call for a battery of varied equipment.

In brief, the features that make the "99" a *must* machine for many mountain trail jobs also makes it a *standout* for urban street maintenance and construction. Among the jobs a "99" takes in stride are heavy scarifying, street widening, shouldering, maintenance, oil mix, snow removal and bulldozing. It negotiates the frequent sharp curves of urban street jobs and follows curving ditch lines without backing up. It turns around in half the time required with a conventional motor grader. It makes accurate blade adjustments without stopping.

See this *one-machine* construction and maintenance handler in action ... check its efficiency and economy on your various types of work. The results show why street superintendents from Maine to California are saying "IT'S THE '99' FOR '39."

The AUSTIN-WESTERN ROAD MACHINERY CO.
AURORA • • ILLINOIS

Motor Graders	Crushing and Screening Plants	Motor Sweepers	5-Yard Tractor-Scraper
Roll-A-Planes	Washing Plants	Shovels and Cranes	6-Yard Tractor-Scraper
Rollers	Blade Graders	Bituminous Distributors	8-Yard Tractor-Scraper
Snow Plows		Elevating Graders	12-Yark Hydraulic Scraper

roll to the outside and the foot of the pile, while the smaller ones remain in the center and at the top. This segregation will result in poor construction. 2. Special equipment will be needed to load from the piles into trucks, when the aggregate is needed on the road. Men with shovels cannot load trucks quickly enough; the average small portable loader will not load trucks quickly enough either. Power shovels of ½ or ¾-yard capacity, or of the tractor mounted type, or large-size bucket loaders, must be used; or the aggregate must be raised to an elevated bin and the trucks loaded from the bin.

Therefore, the man in charge of maintenance must give careful attention to the economical handling of materials in bulk, to insure that they will be available in sufficient quantity at the time needed; otherwise the work will be delayed.

Methods of Storage

Roadside Storage. — The relatively small amounts of materials ordinarily needed for patching and surface maintenance, can be stored along the roadside. Bituminous material for such work is ordinarily handled and stored in drums, of which there are two types. The "two-way" drums are of heavy steel and are returned for re-filling after the contents have been used. "One-way" drums are of thin steel and are not returned to the manufacturer, but may be refilled two or three times on the job. Certain very thin drums used for penetration materials are destroyed in opening. Drum capacity is about 55 gallons, and almost any grade or variety of bitumen can be obtained in either one-way or two-way drums.

A number of maintenance units, as the so-called spray or patching outfits, are so built as to carry one or two drums and to draw the material for patching and light repair work directly from the drums. This makes it unnecessary to transfer the bitumen. The use of these is possible only with emulsions and other light bitumens which are handled cold. With the heavier grades of material, which must be heated, a unit with burners is needed, and these have a bitumen heating reservoir into which the material must be poured.

Drums containing bituminous material should be plainly marked on both ends and the side to show the kind of material contained. If of such a nature that it deteriorates when stored, the date when it was placed in the drums should be plainly marked on it. If affected by freezing, the drums should of course be stored under cover; and it is well to have a distinctive color for drums containing such material; and perhaps also another color for drums containing material that deteriorates on storage.

Empty drums should be stacked, with the bung up and the name out, in tiers, with plank, if necessary, between each tier. Drums should be hauled back for refilling at the storage point as soon as convenient.

Excessive use of roadside storage should be avoided because it ties up both material and money. A good organization should provide an even flow of materials to roadside storage areas, so that while ample will be kept on hand for normal work and even for some emergencies, no unneeded reserve will be built up.

Aggregate Storage—Storage piles of the principal sizes and kinds of aggregate for patching, light maintenance and ice control, should be located at needed points. The material for patching and maintenance can be stored in piles on the right-of-way, as on an old section of relocated road. For ice control, the piles should be at the point of needed—i.e., on curves and hills. This roadside storage should be supplemented by a reasonable reserve amount of material at convenient points.

Roadside storage should be planned carefully. Material should never be placed on the shoulders. Even the small piles of material designed to be spread by hand on hills, curves, crossings, etc., in case of icy conditions, should be placed back of the shoulder lines, so that a loading truck will be off the road, even if this requires putting a drain in the ditch and covering this over. On curves, the inside of the curve is a desirable place for such small piles (if well back of the ditch line), but not for larger storage piles. Nor should stock piles for loading into trucks be placed near intersections, or on hills, where the sight distance is short, unless there is ample loading width beyond the shoulder.

Previous installments of this article appeared in January (Essentials of Maintenance); February (Drainage and Subdrainage); and March (Roadsides, Erosion Control and Plant and Equipment).

Material stored along the roadsides should be carefully placed and compactly piled so as to present a neat appearance and cover the least possible area. Material should not be placed near trees or shrubs, and efforts should be made to utilize places where it is difficult to grow grass. As materials are used, care should be taken that the remainder is well piled and that the area uncovered is carefully cleaned.

Storing Other Materials—Piping, including corrugated, concrete and vitrified, should normally be kept stored at the central garage until needed. Materials for guard rails, as posts, panels, cables, etc., should also be kept at a central or other convenient warehouse or storage point. Cables should be kept on spools, and a notation made of the amount used, and the date, with the amount remaining on the spool noted. Guard rail material should be protected against the weather.

Cement deteriorates rapidly in storage and unnecessary carryovers should be avoided. It must be stored under cover, on platforms at least six inches above floors and from outside walls. Care should be taken to use first that which has been longest on hand, if it is suitable for use. Calcium chloride must be stored in the same manner as cement; in paper bags, calcium chloride is liable to cake after prolonged storage, and not more than a few months' supply should be provided. Chloride in drums will not cake if the stopper is replaced properly after each opening. Sacks contain 100 pounds; drums, 400 pounds.

Brick should be stored only in small quantities; when needed on the job, shipment can be made directly from the plant. Snow fence should be stored under cover and off the ground, as near to the point of use as possible. In many cases, arrangements can be made with property owners for storage. When taken down in the spring, the fence should be carefully rolled and each bundle marked as to location. Before rolling (it should be rolled the same way each time), the fence should be inspected, cleaned and properly repaired.

Other material not normally used except at intervals or in emergencies, should be stored at one or more central points in sufficient quantity to cover only probable immediate requirements of use.

Maintenance of Untreated Surfaces

In this section will be discussed some of the procedures for maintaining untreated surfaces. For the purpose of limiting the material presented herewith, the following types of surfaces will be considered: Ordinary earth roads, sand clay and top soil, gravel and traffic bound macadam. There are, of course, many other types, most of them used locally, or to a comparatively small extent, as cinder, shale, red dog, caliche, shell, etc., which will not be considered here. Stabilized and water bound macadam surfaces will be treated in a later section.

General Considerations.—The problems incident to maintaining the surfaces enumerated in the preceding paragraph, are of two types: 1. Those common to all; 2. Those in which the procedure is based on the type of surface or surface material.

The first heading will include drainage, ditches, culverts, crown, widening, and other improvements. Under the second may be listed surface maintenance, patching, dustlaying and similar items.

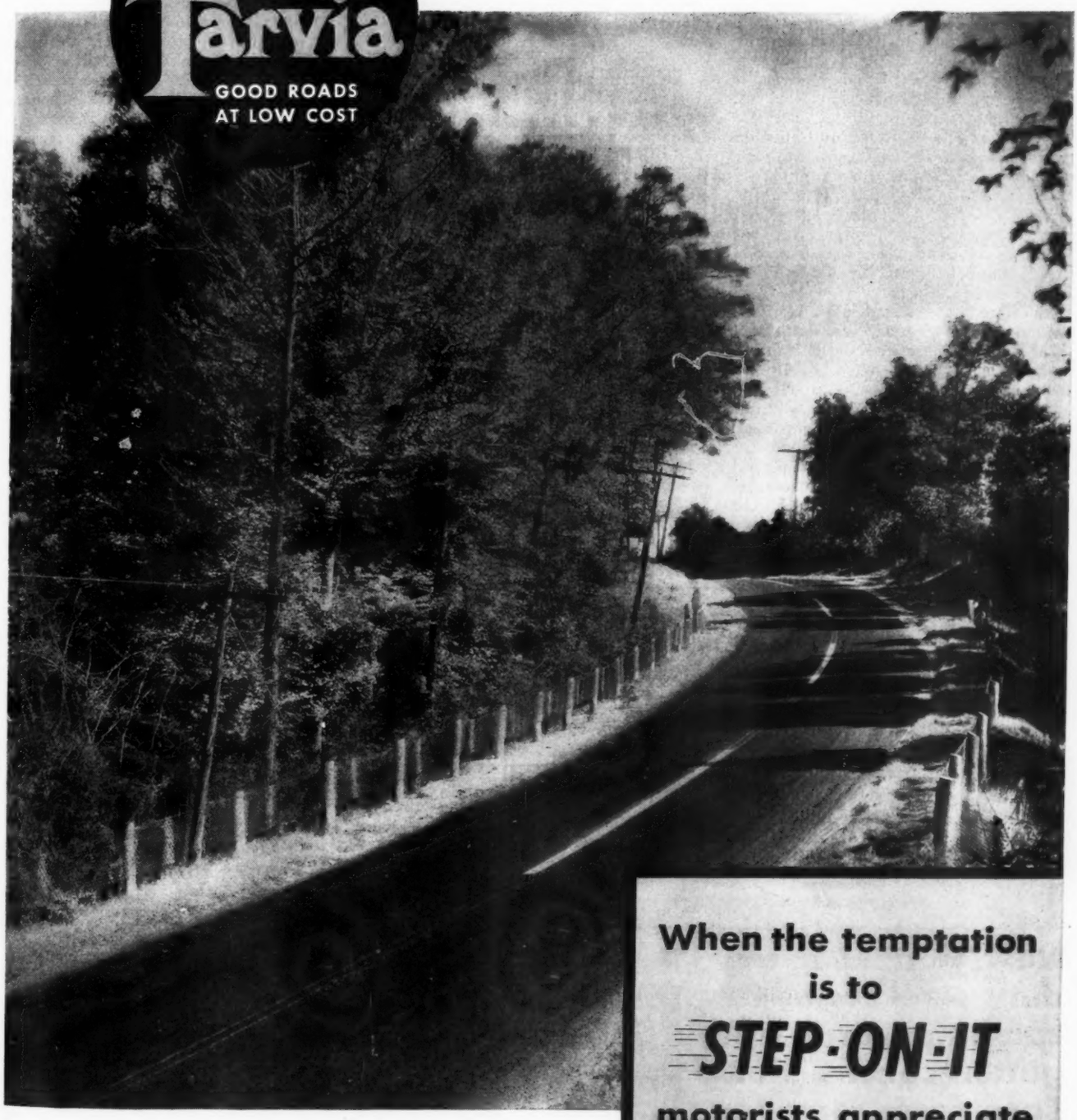
Several of these subjects were discussed broadly in a previous section; in this section, a more direct application will be made to the types of roads under consideration.

Equipment for this work includes both the blade grader, tractor drawn, and the motor grader or maintainer. In the past two years developments in the motor grader have peculiarly fitted it for such work. These include: Low pressure tires and tandem drives have provided all needed power; leaning front wheels; and greater ranger of blade positions, permitting back sloping, etc.

Drainage.—First and foremost in the maintenance of these types of surfaces, is the application of the old formula for a good road—"a dry cellar and a tight roof." This means good drainage and a surface so crowned and smoothed that it will turn rain water to the side ditches. These are primary essentials for untreated roads.

On roads of this type, the best ditch for general purposes is one that can be

Barrett
Tarvia
GOOD ROADS
AT LOW COST



When the temptation
is to
STEP-ON-IT
motorists appreciate
"TRACTIONIZED"
Skid-Safe Tarvia
Pavement

THE BARRETT COMPANY

New York Chicago Birmingham St. Louis Detroit Philadelphia Boston
Providence Lebanon Rochester Baltimore Minneapolis Cleveland Columbus
Toledo Youngstown Syracuse Hartford Buffalo Cincinnati Bethlehem
Portland, Me. Norwood, N. Y. In Canada: THE BARRETT COMPANY, LTD.
Montreal Toronto Winnipeg Vancouver

America's leading manufacturer of coal-tar products

ROOFINGS • TARVIA • CHEMICALS

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 52 to 57

cut and maintained with a motor maintainer or a blade grader. The lack of importance of these types of roads and the usually limited amount of money that can be spent on them, will ordinarily prevent the use of hand labor on ditches, except for cleaning out at culvert inlets and outlets. Since a maintainer or grader must be employed, ditches should generally be broad and shallow, which is desirable from the factor of safety, as already stated, and also permits machine maintenance.

Paved or covered ditches are generally too costly for roads of this type, but on steep grades it may be economical to pave a ditch with local stone to prevent wash and erosion from heavy rains. Earth roads are easily damaged by flood waters, and prevention, especially in those areas subject to fairly frequent damage, is a good proposition. The superintendent or maintenance foreman will know where such sections are located and should investigate the possibilities of preventive work.

A fairly high roadbed is desirable—many authorities urge that it be 18 to 24 inches above the ditches. This has two advantages, that the water level in the ditches is low as compared to the road, thus probably reducing the tendency of the water to soften the subgrade, and drifting of snow is reduced in winter, because winds tend to blow the snow off the elevated surface. The latter advantage is greater in the flat sections of the middle west than in the hilly sections of the northeast. In the south, snow is scarcely a problem of enough importance to justify any expenditure to prevent it.

A gradual slope from the roadway to the ditch is desirable, as it keeps the water at a distance from the road, probably reducing the tendency for the water to seep under the road surface; it permits a safer shoulder for traffic to use in an emergency; and it reduces erosion and permits the use of ordinary maintenance equipment for cleaning and reshaping the ditches.

In making ditch cuts, it is desirable to keep the power unit, whether it be a tractor or a power maintainer, on as good a footing as possible. When a tractor is used to pull a grader, the line of draft should be kept as near as possible in the line of travel of the grader. Manufacturers have a number of draft devices for accomplishing this.

In cutting a ditch with a blade grader, first set the blade at the proper cutting angle with the point directly behind the front wheel, and then shift the frame on the rear axle so that the rear wheel will follow the point of the blade in the bottom of the ditch. For working in wet soils or in roots, sharper angles of the blade are required than when working in light soils. In general, 35° to 40° will give good results. Experience will soon show the grader operator the angles at which the blade cuts best for a particular soil. (Nikirk[6])

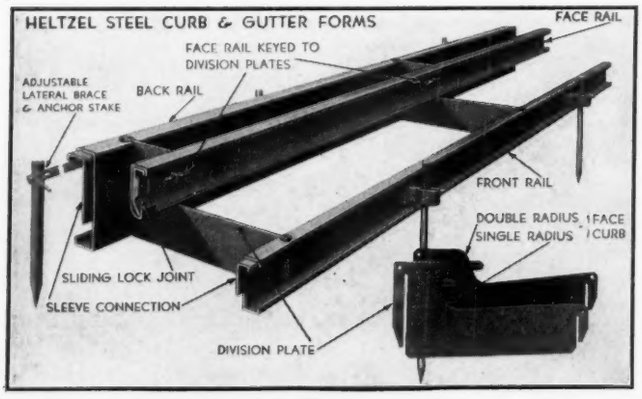
Cross culverts should be provided at frequent intervals because earth ditches are subject to erosion at relatively low velocities. Ditch checks may be installed where cheaper than local stone or other paving, or ditch lining. Directions for installation have already been given.

Crown.—The crown that should be used on earth roads, has been quite well established locally; usually it will be from ½ to ¾ inch per foot, but this may depend also on the type of soil. A light sandy soil that drains well, will require less crown than a heavy clay surface, which is highly susceptible to absorbing enough rain to become muddy and rutted.

The finished surface should be smooth, and as compact as possible. Ruts or depressed areas hold water, and under traffic turn into mudholes. Therefore, one object of maintenance should be to keep the surface uniform in section to facilitate quick removal of rain water from it.

Widening.—Most dirt roads, especially in the east, are too narrow. Widening can be accomplished in connection with ordinary maintenance, usually with very small extra cost. The wider road has another advantage, in that traffic is not concentrated in one track.

Tractors and blade graders or heavy maintainers will widen roads cheaper than any other combination of equipment where the material can be moved and wasted on the road proper, thus requiring only a horizontal movement of dirt. On modern equipment the blade can be swung out to one side and used in this position for backsloping the bank. On the next round



New Heltzel heavy duty steel forms for combined curb and gutter construction. Face form removed without disturbing front rail, back rail or division plates. Catalog S-20.

Heltzel
BUILDS IT BETTER

BINS: Portable and Stationary
CEMENT BINS: Portable and Stationary
CENTRAL MIXING PLANTS
BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
BITUMINOUS PAVING FORMS
ROAD FORMS (with tip curb and integral curb attachments)
CURB FORMS
CURB AND GUTTER FORMS
SIDEWALK FORMS
SEWER AND TUNNEL FORMS
CONCRETE BUCKETS
SUBGRADE TESTERS
SUBGRADE PLANERS
TOOL BOXES
FINISHING TOOLS FOR CONCRETE ROADS

HELTZEL STEEL FORM & IRON CO
WARREN OHIO U S A

Hotstuf
TRADE MARK REG.
Contractors Equipment
ASPHALT HEATERS . . . SURFACE HEATERS
PAVING TOOL HEATERS AND TOOLS
HI-SPEED TRAILER TOOL BOXES
Distributors in Principal Cities
MOHAWK ASPHALT HEATER CO.
FRANKFORT NEW YORK

FRINK
SNO-PLOWS
TRADE MARK
CARL H. FRINK, Mfr.
CLAYTON 1000 Islands NEW YORK
DAVENPORT-BESLER CORP. DAVENPORT, IOWA.
FRINK SNO-PLOWS OF CAN., LTD. TORONTO, ONT.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 52 to 57

of the grade, the blade will pull the dirt that has been cut off the bank up onto the shoulder.[7] Proper backsloping reduces slumping of banks and washing of material into ditches, causing stoppages that may result in washing out a section of the road.

A cut should not be made until the operator is sure where he is going to place the material.[6] Therefore, advance planning and consideration should be given to the work to be done. The foreman should look over the area that he intends to widen, determine how much dirt is needed, where it is coming from, and where it is to be placed. This advance planning will facilitate operations and will result in a better and more uniform job, with the fewest number of operations.

It is sometimes advantageous to reverse the blade and make a second cut in the opposite direction of travel. This tends to overcome slight irregularities, to fill up depressions and to cut off high spots.

In widening on steep side hills, some of the dirt must be brought across the road and pushed over the down-hill side. If the road is to be widened several feet, a low retaining wall on the downhill side, or plowing of the area that will be covered, will tend to prevent erosion or slipping of the fill slope.

According to Nikirk,[6] tractors and blade graders and maintainers are effective on slopes of not more than 30°. On steeper slopes, a bulldozer or other unit should be used. Though this statement applies particularly to new construction, it is also true in widening work.

Austin-Western "99" grader—an example of modern equipment

In this connection, tractor scrapers of various types have been developed to a point where they, also, are highly efficient for any work that involves handling dirt, including cutting to a grade, clearing ditches, etc. Where widening involves any haul, they are of particular value.

Other Improvements.—Grade reductions can sometimes be made by cutting down the road at high points and bringing the material into hollows or low points. In rolling country, such work is perhaps more effective in reducing rise and fall and improving vertical sight distances, often important factors.

Alinement can also be bettered in the same manner, by planning in advance what it is desired to do. By the intelligent use of the grader and tractor, every trip across a road can be made to improve that road.

Summary. — The superintendent or foreman should study the roads under his charge. The first step should be to note their condition in relation to the needs of traffic, and to determine what is possible in the line of improvement without exceeding the funds that are available for the work.

Danger spots to traffic and points that are often or usually in bad condition and require frequent maintenance should have first attention. These points should be studied in order to determine what improvements are possible in connection with maintenance work, and at the expense of a reasonable amount of equipment and man time. Consideration should also be given to road sections in front of schools, churches, and similar places, in order that these may be as safe and convenient for use as possible. Roads at such places should be wide enough to permit passing and the shoulders should permit parking, and unloading of children from school buses.

Earth Road Maintenance

It is manifestly difficult to consider in one article the maintenance of the most unimportant rural dirt roads and also the maintenance of those roads that carry considerable traffic. Whereas, according to the Bureau of Public Roads, earth roads are suitable for traffic up to 100 vehicles per day (and when built of sand clay or selected materials, up to 300 vehicles per day), there are many earth roads which do not carry more than 25 vehicles per day. Day by day maintenance, as dragging, is generally out of the question with these minor roads.

As early as practicable each spring and in the late fall before the first freeze, selecting a time when the moisture content of the road is most favorable for working, earth roads should be shaped and smoothed with a grader or maintainer. Proper crown should be given the surface, the ditches cleaned, and the shoulders smoothed. Care should be taken that undesirable material is not bladed from the ditches onto the shoulders or the surface.

The spring treatment puts the surface in shape to withstand summer traffic; the fall treatment is designed to place the road in good condition before the ground freezes. From time to time, this operation should be repeated during the summer months. The frequency of this work will depend upon the importance of the road and its condition, and upon storms, as it is desirable to repeat the treatment after every severe storm. When blading operations on an earth road are in progress, no greater section should be opened up than can be completed during the day, so that the road will be as safe as possible for traffic during the night. A ridge of material should never be left in the traveled roadway.

On the surfaces that carry a greater amount of traffic, smoothing operations should be scheduled more frequently—as daily, two or three times a week, or once or twice a month. Such work is generally best performed by one man with a motor driven maintainer. Some counties and townships have found that it pays to have one laborer accompany the operator.

In general, such a team or unit is assigned to a definite area or amount of road, which is determined by the distance that must be patrolled every day and the number of days between the trips over each section. Whenever possible, blading should be done when the road surface is moist but not wet.

Road drags, either horse-drawn or pulled with a light motor truck, are suitable for light maintenance.

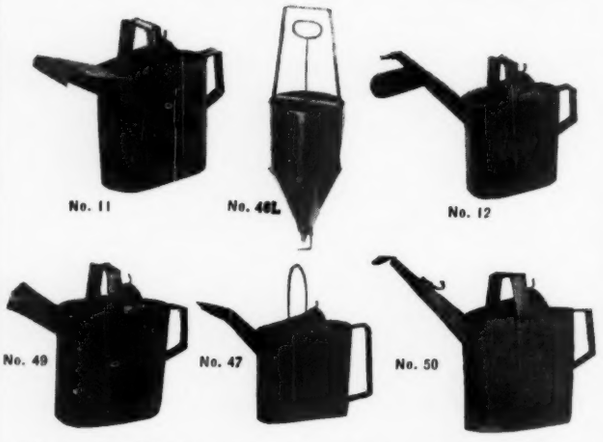
Maintaining Gravel and Traffic Bound Surfaces

Gravel, sand-clay, traffic-bound macadam and top-soil roads require the same general procedure in maintenance as do earth roads. However, because roads of this type normally carry greater amounts of traffic, more intensive maintenance is required. Surfaces of these materials are usually maintained with a somewhat flatter crown than earth roads—about ¼ inch to the foot. Some localities build up the crown slightly during the wet seasons.

The prerequisite to maintenance is, of course, proper drainage. With that taken care of, every effort should be made to keep the surface well-shaped, smooth and compact. The following is abstracted from directions issued by the Montana State Highway Department.

Intensive maintenance should begin as soon after the spring breakup as road conditions will permit. Advantage should be

"TARCO" TAR AND ASPHALT
POURING POTS



These welded, screened and hooded pots are light, strong and accurately balanced. They are correctly designed for maximum savings in time and material. Many types for sheet, line or crack pouring of both hot and cold bitumen.

For Literature or Prices Write

TARRANT MFG. CO., SARATOGA SPRINGS, N.Y.
ASPHALT SPRAYERS—STREET CLEANER'S CAN CARRIERS

Deals with all Phases of Water Supply

WATER SUPPLY and PURIFICATION

By W. A. HARDENBERGH
Asso. Editor, PUBLIC WORKS

Design problems are explained, then illustrated by worked out examples in this new book so the principles can be applied to your own job. Meets needs of practicing engineer and superintendent. Complete and authoritative, making it unnecessary to consult other texts in working out water works problems. Send $4.00 for a copy today. If not entirely satisfied you may return it within 5 days for refund in full.

MONEY BACK IF NOT ENTIRELY SATISFIED

CONTAINS 31 CHAPTERS COVERING:
Consumption
Rainfall, Runoff, Evaporation, etc.
Surface Water, Ground Water
Reservoirs
Pipes and Conduits
Laying Pipe
Planning a Distribution System
Designing Distribution Systems
Pumps and Pumping
Water Tests and Analyses
Treatment of Water
Softening
Control of Corrosion
Disinfection
Taste and Odor Control
How to Design a Treatment Plant
458 pages; 148 illustrations, $4.

ORDER YOUR COPY NOW

Book Dept. PUBLIC WORKS, 310 East 45th St., New York, N. Y.
Enclosed find $4.00 for which send me WATER SUPPLY AND PURIFICATION by Hardenbergh. If not satisfied I may return book in 10 days and you will refund my money in full. 4-39

Name..... Title.....
Street .....
City..... State.....

taken of the moisture present in the road materials to insure thorough compaction of the surface. In order that gravel and rock surfaces may be given the maximum attention in the spring, all ditch cleaning and slide removal work should be completed in the late fall before the freeze-up.

Advantage must be taken of every rain during the maintenance season by continuous blading of the material while it is wet. Excessive loose and inert surface material should be bladed to the shoulders, well beyond the traveled portion of the roadway, but care should be taken that this material is not lost over the shoulders.

Maintenance is commonly effected by a one-man grader, or by dragging. On gravel surfaces having a traffic of more than about 200 vehicles per day, daily dragging or blading is desirable. With less traffic, alternate days will be sufficient.

Gravel is best when it is well graded and contains sufficient binding material to hold the larger particles in place. When the road has dried out, the bond may become weaker and break down. The fine materials are then broken loose and may blow away or be thrown off the road by the action of traffic. The remaining coarser particles act as abrasives and wear the surface. For this reason, some maintenance organizations do not allow loose material to remain on the surface. Others maintain the surface with a loose mulch, spreading a thin layer over the surface, and leaving the excess in a windrow at one side.

Under the latter plan, each time the road is patrolled, the windrow is worked across to the opposite side of the road, leaving the surface lightly covered. If the surface is such that the loose gravel will work into it, this is a good method; but if the surface is hard, such procedure results in a loose layer of material that may cause skidding, and probably causes abrasion and the production of excessive dust.

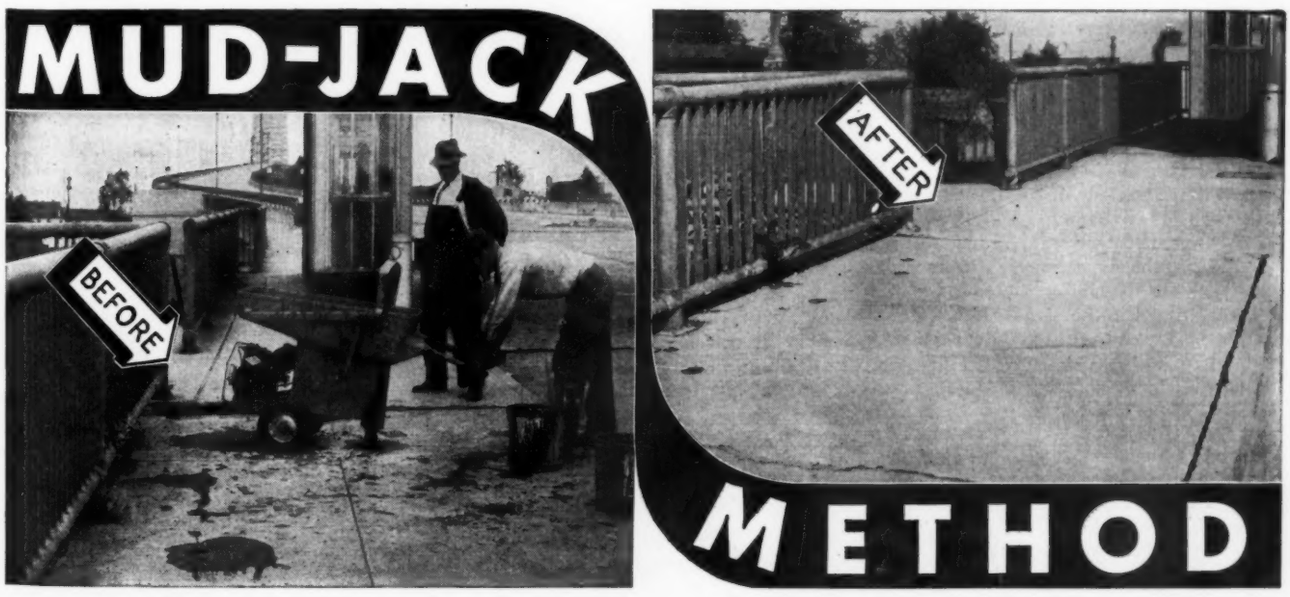
Maintenance by Semi-Stabilization.—In this method, the purpose is to provide a mixture of coarse, medium and fine material—i.e., gravel, sand and clay—in such proportions as to make a dense surface layer. In doing this, when the loose material is bladed to the side, which should be done with a light blade pressure when the road is dry, it must be mixed with clay, in order to provide the necessary bond, before being put back onto the road surface. Care must be taken to have and to keep a mat sufficiently thick to hold the gravel, or this method will fail. The addition of all new material would eventually build the road too high, and would require too much material. Therefore, with the grader blade, material is cut from the road surface, mixed with the loose material that has been bladed to one side, and with clay for a binder, and then bladed back into the road. This work should be done in wet weather, and no more length of road should be worked on than can be finished that day, since passing traffic will pack down the binder in the road and interfere with the bond between the old and newly mixed and added material.

This method is called semi-stabilization —a stabilized road being one where the aggregate and binder are accurately proportioned. The semi-stabilized road thus consists of gravel that is bound together with clay or soil, usually obtained from the ditch or shoulder. In roads of this type, there will be about 10% to 12%, by weight, of binder. Calcium chloride or salt may be added (which subject will be discussed later), in which case the mixture may be leaner in the amount of binder materials.

In maintaining these semi-stabilized roads, blading should be done only after a rain, and care should be taken not to tear up the compacted surface, except as necessary for building up a mat. In most cases there will be a slight accumulation of loose material on the shoulders which should be mixed by the blade with clay from the shoulders or with any excess of clay that may have accumulated on the surface of the road. This clay-mortar surfacing should be worked back and forth across the road to even up ruts and pot holes; then left for traffic to compact.

If the binder is in excess of what is needed, these roads may become slippery after rains. If deficient in binder, some raveling may occur in cases of long periods of dry weather. If a road shows a tendency to ravel, added binder should be worked in after the next rain. Chloride is a help in preventing raveling on such roads because it maintains a better moisture content and bonding between the particles.

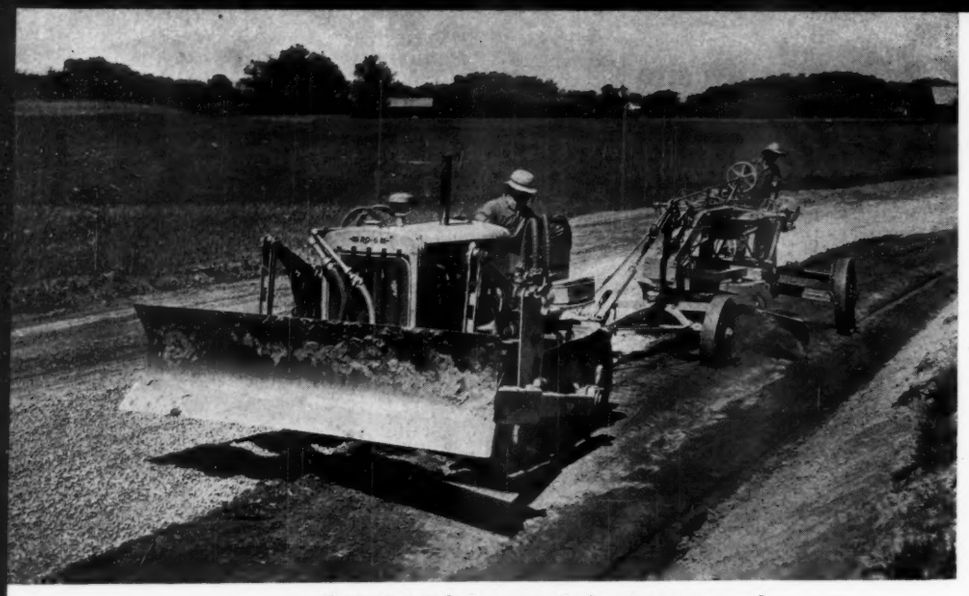
Untreated gravel surfaces will lose



Sunken concrete slab is raised to correct grade by the Mud-Jack Method — preventing breakage of the slab and eliminating reconstruction costs.

Increase the life of concrete slab by the Mud-Jack Method. Write for information about economical maintenance of curb, gutter, and sidewalk slab.

KOEHRING COMPANY
Pavers · Mixers · Shovels · Cranes
Draglines · Dumptors · Mud-Jacks
3026 WEST CONCORDIA AVE. MILWAUKEE, WISCONSIN



Important tools in economical maintenance work

about ¾ to 1 inch of surface depth a year through abrasion and blowing away of fine particles. This lost material must be replaced if a sufficient depth is to be maintained.

Patching.—On gravel and traffic bound surfaces, holes and depressions may be patched with damp stockpile material containing sufficient binder. The failed section, and a few inches around it, should be cut out, preferably to a square or rectangular shape, and to the maximum depth of the hole. The sides should be vertical. All dry and loose material should be removed. If the hole is dusty, it should be wetted. An excessive amount of material should not be used, so as to cause a hump on the surface. The hole should be filled with material tamped in thin layers to about the same density as the original surrounding surface.

Washboards and Corrugations.—Gravel and other like surfaces have a tendency to develop corrugations, sometimes called washboards or chatterbumps. If these corrugations are not too deep, and if the work is done when the surface is wet, it is sometimes possible to cut off the tops of the corrugations with the grader blade and use the material to fill the depressions. One trip over the road will not usually complete the job, because the bumps are firm and compacted while the material deposited in the hollows is not compacted; and when traffic has packed it down, the bumps and hollows will still remain, though not to the same extent as before. Therefore, a road that is in this condition should be worked over several times until the hollows have been filled with compacted material.

Such bumps usually occur in dry weather, at which time the road cannot be worked satisfactorily. If dry weather persists, the section may be sprinkled just in advance of the grader or maintainer. Too much water interferes with the bond, so care must be taken to have about the right amount. Since this will vary with the soil or gravel texture, a little preliminary experimentation will be desirable.

If the corrugations have become deep, it will probably be necessary to scarify the surface, re-shape it with the grader blade to the proper section and roll. Most maintainers, rollers, and graders have a scarifier attachment which is suitable for such work. Large stones that are loosened by scarifying, should be removed from the road; and in building roads of this type, larger stone — those exceeding 2 to 2½ ins.—should be excluded from the top 6 or 8 inches.

Dust Control

Dust is not only a nuisance, but an actual danger to traffic. The clouds of dust raised by a passing automobile, obscures the road ahead and hides the hazards that may exist. In addition, the dust represents a loss of valuable road material, which must be replaced. Calcium chloride and bituminous applications are normally used for dust prevention.

"Spot" treatment for dustlaying where the entire road cannot be treated, is particularly valuable as a builder of good will and a safety measure. For the first mentioned purpose, spot treatments can be made in front of schools, churches, and residences, and through settled communities. As a safety measure, applications should be considered at both ends of all bridges, at cross-roads, road intersections, on curves, over crests, and at other danger spots. Often a farm or industry will cooperate in the carrying a part of the cost of such work.

Bituminous Treatment.—If the highway is of the ordinary dirt road type, an application of 1/3 to 4/10 gallons per square yard of MC-1, which is a medium curing light asphaltic material, will penetrate into the surface without leaving a surface mat. Due to the penetrating qualities of this material it is not necessary to cover it with a blotter as the material itself tends to bond the dirt aggregate together. Two applications of this product during the season will lay the dust and also tend to waterproof the road.

Instead of using two applications primarily as a dust layer, it would be better engineering to apply the first coat of MC-1 and within a period of from ten to thirty days later apply a second coat of a surface treatment cutback at the rate of 1/3 of a gallon per square yard and blot it with ⅜" to ⅝" crushed stone or gravel, or if these are not available or too expensive the cutback can be applied in a smaller amount and blotted with a good grade of bank-run gravel or coarse sand.

By treating dirt or gravel roads in this manner, weather and wind erosion are eliminated and the asphaltic materials used primarily to lay dust will during the following years act as a soil stabilizer and foundation for the heavier type wearing course, or for a surface treatment wearing course if so desired.

Calcium Chloride.—For general use as a dustlayer, and also as a surface binder, the calcium chloride is distributed uniformly over the surface, using the flake form. A spreader is highly preferable in order to obtain even distribution.

For best results, calcium chloride treatments should be made as two or more light applications, rather than as one heavy one. The intervals between applications will depend on the weather. Calcium chloride should not be applied if there is a possibility of rain within two or three hours after application, since the rain will wash away some of the material; but rain that occurs after the flakes have been dissolved has no effect. On loose surfaces, as uncompacted gravel, application shortly after a rain gives better results. Application need not be made nearer than a foot from the edge of the surface. Do not use calcium chloride on a surface that has previously been tarred or oiled, except upon advice from the manufacturers.

Workmen should wear rubber boots or rubber soled shoes while applying the chemical. While not aggressive nor corrosive, calcium chloride absorbs moisture and will leave leather hard and dry. After it has been absorbed into the road surface, this action is no longer possible.

About two pounds per square yard per season, are required for dustlaying under average conditions. The first application should generally be about ¾ pound per square yard to 1¼ pounds per square yard. When the first signs of dryness in the road appear thereafter, a second application of ½ to 1 pound per square yard should be made. On roads having a high clay content, less calcium chloride is required. On sandy or stony surfaces, the first application can be as much as 1 to 1½ pounds per square yard.

References:

[6] Roads, Canals and Embankments with Caterpillar Equipment.
[7] Modern Methods of Moving Earth, Milligan, Cleveland Tractor Co.

Taking the Rattle Out of Manhole Covers

By R. V. TERRILL
City Engineer, Coldwater, Mich.

THE need for some sure and permanent remedy for rattling manhole covers becomes apparent immediately one is connected with public works, because they are a source of numerous complaints. It will be noted moreover, that these complaints are apt to come from covers where the trouble seems to recur frequently, while other covers never seem to cause trouble; for if a cover seats properly it will never cause much noise, and if it does not seat properly it will continually rattle when cars pass over it with a strong tendency to arouse the wrath of sleeping neighbors. In Coldwater we have found no trouble due to dirt or rust under the cover—where they rattle it is almost sure to be due to an irregular metal surface.

We tried several remedies with no permanent success. Finally we hit upon the idea of grinding or lapping the cover into a flat seat, somewhat after the manner of grinding motor valves.

We have a Fordson tractor with a power takeoff for driving a rotary sweeper on the front of it which we adapted to the purpose, using an old Model T rear axle assembly for a bevel gear and vertical drive. The axle housing is mounted in a three-legged frame and cannot turn but can be raised and lowered by a lever provided for the purpose. Of course, the axle assembly is cut down somewhat and the axle line is vertical. The spider gears are welded to the ring gear. The frame is set over the manhole and the vertical shaft secured to the center of the manhole cover, using in the shaft a universal joint just over the cover which allows the cover to seat itself while being turned. Just below this universal joint, there is a coupling consisting of a square shaft, sleeve and pin. This square shaft goes down through a hole in the center of the cover and is threaded to take a 5/8" nut on the lower end. Just above the cover a 12" round plate is welded to the shaft, and near the outer edge are three set screws which turn through the plate and bear on the top side of the manhole cover. This plate assembly is secured to the cover, after which the drive assembly is mounted over it and connected to it.

When ready to run, the entire axle assembly and cover can be raised and lowered by the lever, not unlike the action of a drill press. In fact, the outfit could be used to drill a center hole in the cover if there was none. Before grinding, we cut small grooves with a diamond point chisel under the edge of the cover, which run diagonally inward on the bearing edge of the cover and tend to drag the abrasive under as the lid turns, thus counteracting the centrifugal force which would throw it out. As a safety shield, a piece of old inner tube is slipped over the drive shaft.

With everything connected, we start the cover turning and add the abrasive. This is No. 90 Aloxite grains mixed to a thin paste with cylinder oil. The cover is turned about 60 r.p.m. Of course, the high points on both the cover and frame grind fastest and at length work into a flat seat.

This summer we have ground around 40 covers. The average time is around two hours. A man and tractor could run the outfit although I have used two for safety, as a couple of shafts were exposed. Our cost ran around $2.00 per cover. This can be reduced considerably, although we feel that this cost is justified because once we grind a cover it is through rattling once and for all.

YOU CAN'T CLOG IT

MUCK! GRAVEL! CINDERS!

GORMAN-RUPP PUMPS
UNSURPASSED FOR PUMPING FAST

"Old Faithful" that's what construction and maintenance men everywhere call their G & R self-priming centrifugal pumps. Fool proof because they're gadget-less. They've got something the others haven't — simplicity. They can't clog — they're not quitters.

The only pumps with renewable wearing plate—they're modern.

G & R's will deliver more water per hour and pump more hours at less cost—under any conditions.

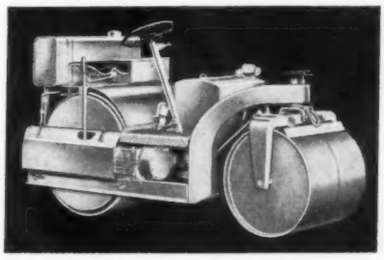
WE WILL SHIP YOU ONE and LET YOU BE THE JUDGE!

You'll find them THE MOST DEPENDABLE PUMPS FOR THE LEAST MONEY—bar none.

WRITE

PROMPT DELIVERY ---- from Stock In 100 Principal Cities....

THE GORMAN-RUPP CO., Mansfield, Ohio



C.H.&E.

THREE-TON ROLLER

Also Available in Two-ton Size

IDEAL for airports, shoulders, paths, patching, sidewalks, driveways, playgrounds, etc. Forward and reverse speeds. Indispensable for small cities and villages. Send for complete catalog.

Also write for literature on our Saw Rigs, Pumps, Hoists, Elevators, Bar Benders and Cutters.

C. H. & E. MFG. CO., 3841 No. Palmer St., Milwaukee, Wis.

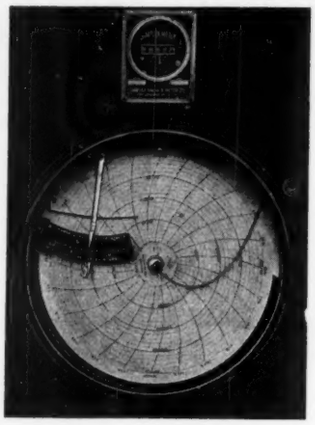
OSGOOD

POWER SHOVELS—CRANES DRAGLINES, Etc.

Write for New Descriptive Bulletins

THE OSGOOD CO.
MARION, OHIO

When writing, we will appreciate your mentioning PUBLIC WORKS.



SPECIFY SIMPLEX METERS

WHEN you require ACCURATE, SENSITIVE, WIDE-RANGE Flow Meters.

AVAILABLE to indicate, record, or totalize the flow or in any combination of these functions SIMPLEX METERS will satisfy your most rigid operating requirements.

✓ CHECK WITH SIMPLEX

Simplex Valve and Meter Co.

6750 Upland St. Philadelphia, Pa.

GET PERFECT JOINTS

by Using

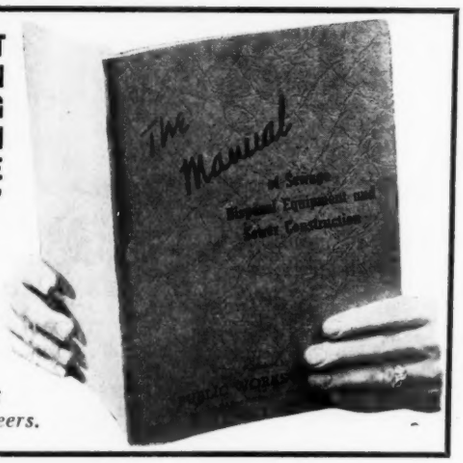
WESTON

GASKETS and FORMS for all SEWER PIPE JOINTS

Minimizes infiltration, exfiltration. Prevents root intrusion. Literature FREE

L. A. WESTON, ADAMS, MASS.

"A GREAT HELP WHEN WORKING UP DATA ON SEWAGE DISPOSAL"



. . . say leading sanitary engineers.

Brom-Cresol Green-Methyl Orange As Alkalinity Indicator

By F. M. Hull, Columbus, Ga.

An article in Industrial and Engineering Chemistry deals with investigation by various fertilizer industry chemists for a better indicator than methyl orange for use in determining the acidity or basicity of fertilizers by titration. After giving a rather detailed report of the various indicators and combinations of indicators used in the investigation, the authors arrived at the conclusion that a combination of brom cresol green and methyl orange gave results that were superior to any other indicators tried out.

Through the courtesy of Mr. Miller of the Nehi Bottling Company, of Columbus, the writer has had the opportunity to try out this new indicator in connection with routine determination of total alkalinity of water. The results have been most gratifying. The familiar difficulty of detecting the methyl orange end point in turbid waters is eliminated, the new indicator being blue in alkaline solutions and yellow in acid solutions, with a rate of change sufficiently slow to give ample warning of the approaching end point.

The solution that has been used by the writer is made up of 0.1% bromcresol green, and 0.02% methyl orange. Quoting from Industrial and Engineering Chemistry the solution is made as follows: "The most satisfactory method of bringing both indicators into solution is to weigh 0.1 gram bromcresol green and 0.02 gram of methyl orange into an agate mortar, and to grind these with a pestle as small amounts of sodium hydroxide solution are added, using a total of 2 c.c. of 0.25 normal sodium hydroxide, or its equivalent. The solution is transferred to a beaker and then to a 100 c.c. volumetric flask and made up to volume with distilled water.

Ten drops of indicator solution are used per 150 c.c. of sample. While small variations from this amount give equally satisfactory results, it seems best to keep the ratio of indicator to solution to 1 drop per 15 c.c. of solution being titrated."

According to the investigators, the end point of this solution is at approximately pH 4.3, which compares favorably with the methyl orange range of pH 3.1 to 4.4. The writer has been using a ratio of 7 drops of indicator to 100 c.c. of sample, and as stated above the results have been very gratifying. *Georgia Faucet.*

Adding Chemicals to Water Supply in Buildings

For several years the Department of Health of New York City and the Department of Water Supply have felt that there should be some official regulation of the addition of chemicals to water supply systems inside the buildings where used, which addition is practiced in many buildings to reduce corrosion of piping systems; there being definite possibilities of the occurrence of mistakes or accidents which might affect the quality or safety of the water in the buildings or even in the city mains outside. After a number of conferences, the Board of Health has adopted regulations to effect such control, to become effective April 1, 1939.

Under these regulations, no arrangement for adding chemicals shall be installed except by a person or firm holding a permit therefor from the Commissioner of Health. Such chemicals shall be for anti-corrosion or anti-scaling purposes only, and shall include only one or more of the following: Sodium silicate, sodium

carbonate, sodium bicarbonate, sodium hydroxide, sodium phosphate, calcium carbonate, calcium bicarbonate, and calcium hydroxide. This does not apply, however, to treatment of water for industrial purposes, swimming pools, air conditioning, or other uses that do not include human consumption, provided such treated water can not come into contact with or contaminate the potable water supply.

Neither the total alkalinity, total hardness or total silica content of the water shall be increased by more than 50 p.p.m. by the addition of such chemicals. Apparatus used for applying chemicals must be approved by the Commissioner of Health, who may appoint an advisory committee composed of representatives of various technical societies.

Washing Sand Filters in Hartford

The filters of the Hartford, Conn., Water Bureau are washed from one to three times a year and harrowed several times between rakings. From 1 to 3 of the 10 half-acre beds were resanded each year up to 1932, an average of each bed once in 5 years. Up to that time a Nichols washer had been used. During 1932 a Bayard washing machine was installed for washing the sand in place, and no beds were resanded until 1936, when one was resanded, and three in 1937.

During 1937 the beds were hand-raked twice and harrowed 78 times with a tractor-drawn harrow and washed with the Bayard washing machine. For comparing the results of this operating procedure with that formerly used, the top 5 inch of sand in one of the half-acre beds was reconditioned with a Nichols washer followed by hand rakings, instead of harrowings, when necessary. Removing, washing and replacing this 5 inch cost $696.45, or $0.994 per cubic yard handled. Washing 15 beds with the Bayard washer cost $2,263.94, or $150.93 per bed washed.

The resanding of three half-acre beds involved handling 12,460 cu. yds. of sand at a total cost of $6,954.81 or $0.558 per cu yd. This brought the total cost of sanding operations to $9,915.20, of which $8,070.66 was for labor, $586.69 for oil and gasoline, and $1,257.85 for repairs and parts.

The bureau is operating six small experimental filters containing 18″ of gravel, this supporting 24″ of sand in three filters and 36″ in the other three, at rates of 10 to 20 mgad, in an attempt to develop a slow sand filter which will give satisfactory bacteria and color removal, and which can be cleaned and backwashed by rapid sand plant methods, operating at considerably greater rates than present slow sand types.

Algae Control With Potassium Permanganate

Copper sulphate is ordinarily used for algae control. Potassium permanganate can be used under certain conditions, where the water is not used for drinking purposes. In spray ponds, or similar installations, a dosage of about 10 parts per million of potassium permanganate, according to Carus Chemical Co., will control algae. Enough should be added so that the water will turn pink and remain pink for 15 to 20 minutes. A lesser dosage will be ineffective. Before applying the permanganate, dissolve it in hot water, about 1 pound to 1½ gallons. This method of treatment for algae control is not suitable for water that is used for domestic purposes, as the bitter taste resulting from a dose as large as this makes the water non-potable; however, water so treated is not harmful.

QUINN PIPE FORMS

HAND or WET PROCESS

Make concrete pipe on the job with *Quinn Pipe Forms.* Quinn Pipe Forms can be handled by less experienced labor and produce uniform concrete pipe of highest quality. The recognized standard of all concrete pipe.

HEAVY DUTY
CONCRETE PIPE FORMS

Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length. Backed by years of service in the hands of contractors, municipal departments and pipe manufacturers.

NEW
MEDIUM DUTY
CONCRETE PIPE FORMS

Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Complete in every way. Stands up on any job. Same sizes as "Heavy Duty," from 12 to 84 inches—any length.

WRITE TODAY

Get complete information on prices and Special Construction features of Quinn Pipe Forms. Give us size of job for estimate on your pipe form needs.
Also manufacturers of concrete pipe machines for making pipe by machine process

QUINN WIRE & IRON WORKS
1621 TWELFTH ST., BOONE, IOWA

SERVITITE

PLASTIC SEWER PIPE JOINT COMPOUND

Developed after extensive research by the Servicised Laboratories SERVITITE is a plastic cold trowelling joint compound that will give an absolutely watertight joint.

Chemicals are incorporated in its composition which will **positively prevent root growth.**

Furnished in two units—the dry asphalt and the liquid asphalt to be mixed on the job in the ratio of approximately four parts dry to one part liquid by volume.

SERVICISED PRODUCTS CORPORATION is the only manufacturer making all three types of sewer pipe joint fillers—

Preformed—SERVICISED premoulded sewer pipe belt.

Plastic—TUFFLEX ready-to-use bituminous plastic compound. SERVITITE dry and liquid plastic for mixing on the job.

Hot Pouring—SERVICISED Sewer Pipe Compound.

Write for Further Information

SERVICISED PRODUCTS CORPORATION
6046 W. 65TH STREET
CHICAGO - - ILLINOIS

© 1939

Other SERVICISED PRODUCTS: Expansion Joints — Asphalt Joints —Cork Rubber Joints — Sponge Rubber Joints — Fibre Joints. Also the New Bituminous Air-Cell Expansion Joint — Asphalt Plank— **Waterproofings—Waterproofings for Sewer Tunnels.**

When writing, we will appreciate your mentioning PUBLIC WORKS.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

Studies of Filter Bed Operation

Studies of the macro-organisms in the filter beds at Leeds, England, seemed to demonstrate the importance of scouring organisms in such beds, the most prominent ones there being the Lumbricillus Lineatus, which feeds on the algae growth on the filter medium. (At Huddersfield the growth is mainly fungal and the scouring organism is Psychoda.) Insect larvae and other macro-organisms perform a similar function. The worms cluster where these growths are most abundant, but when the air temperature falls below 5° or 6° C they work deeper into the bed; also they descend when the filter is unloading, and when the surface growth dries in summer. The cause of the unloading of the surface growth in Spring is its change from a leathery to a spongy condition, and for this the worms are chiefly responsible. In three or four weeks the growth forms again and the worms migrate into it. Absence of unloading in summer is attributed to the high rate of regeneration owing to increased temperature and sunlight, which lessens the effect of worm depredations. Worms introduced into an inefficient bed with solids rapidly accumulating clear the medium and allow active nitrification to commence, but if the bed is badly choked and septic they may be unable to do this.[D11]

High rates of flow tend to diminish the development of the metazoan population, especially insects and their larvae; also result in a more even growth of film throughout the filter medium, so that when ponding occurs it is liable to be more serious. It may be possible to run filters indefinitely without resting periods if the dosing is at a low rate or intermittent, both of which favor growth of insect population and tend to prevent the accumulation of film.[D13]

Oxygen Utilization By Activated Sludge

Investigating activated sludge-sewage mixtures at temperatures from 10° to 25° C indicated that at all temperatures the rate of oxygen utilization is the sum of two factors; one (usually relatively small) is independent of the concentration of sludge used and has been attributed to the sewage; the magnitude of the second is directly proportional to the amount of activated sludge (suspended solids) in the mixture. There seem to be at least two types of sludge, each giving a different type of oxidation curve. The rates of oxygen utilization at 10°, 15° and 20° are 26%, 43.5% and 70.5% respectively of the rate at 25° (this may not apply exactly to all sludges).[C23]

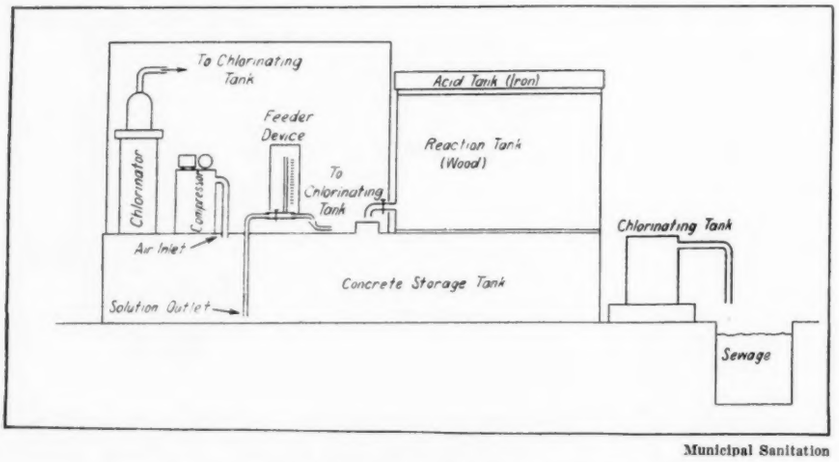
Imhoff Tanks Create Sulphuretted Hydrogen

Five Imhoff tanks at Fort Worth, Tex., combined sludge capacity 1.2 cu. ft. per capita, were so constructed that sludge accumulations could not be removed completely and digestion in them was continuous. Hydrogen sulphide was thus produced and created odors; an average of more than 250 lb. of H_2S daily being produced from 9.674 mgd. of sewage. After 3 yrs. two tanks were changed to straight-flow primary tanks with equal combined capacity and the other three tanks discontinued, and these reduced the H_2S by 80 lb. a day, although the incoming sewage was increased to 11.572 mgd. Also labor was reduced from 10.8 man-hours daily to 0.77. Odor observations taken twice daily, rating odors as none (0), faint (1), distinct (2), and strong (3), showed the odor from the settling tanks to be only 47% as great as from the Imhoff tanks.[C24]

Measuring Turbidity With the Photronreflectometer

Attempts to measure turbidity of sewage by means of a photo-electric cell have not been particularly successful. They used absorption of transmitted light. Recently nephelometric determinations, using the Libby photronreflectrometer, were compared with determinations by the "Standard Methods" and showed greater accuracy; it covers a wider range of turbibities (0 to 400 ppm); a small sample (3.5 c c) only is necessary; and the personal factor is eliminated.

In this appliance, a pencil beam of light is projected through a glass cell containing the sample onto the center of a Weston photo-cell. The area covered by the pencil is blocked out, but rays reflected from suspended particles reach the cell in the area outside this blocked-out area, and the cell measures the amount of these reflected rays but is not affected by those not reflected.[C18]



Municipal Sanitation

General arrangement of El Paso's equipment for copperas production

Copperas Production at El Paso, Texas

For several years El Paso has been making the chlorinated copperas used in its sewage treatment plant, using liquid chlorine and scrap iron. Recently it has changed its procedure, and now dissolves the iron with dilute surfuric acid to form $FeSO_4$, which combines with chlorine to form $FeCl_3$ and $Fe_2(SO_4)_3$. The former process cost about 10 cts. per pound of iron dissolved, the present one about 2 cts. for sulfuric acid and 2.33 cts. for chlorine, equivalent to 36 cts. per mg per ppm of iron added. These costs are based on $5 a ton for scrap iron, 3.5 cts. per pound for chlorine and $20 a ton for sulfuric acid.[H17]

FOLLOW THE ARROWS—

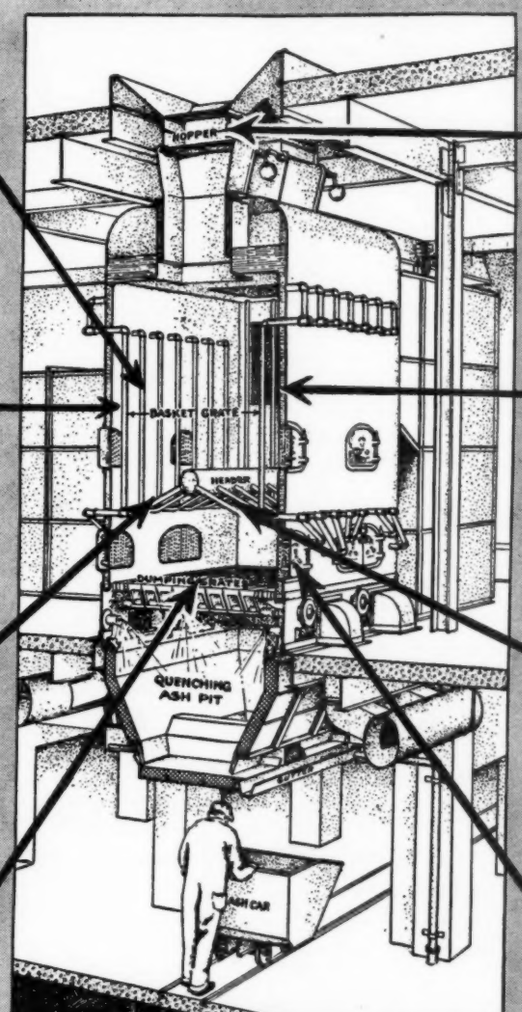
They indicate the important special features of Nichols Decarie Suspended Basket-Grate Refuse Incinerators—the incinerators which are the first choice of discriminating sanitation engineers—municipal, county and state health officials and disposal plant superintendents.

Suspends Wet Material Above, and in Fire
PROTECTS BRICK WORK

Space Between Basket and Walls
ALLOWS HEAT ON BOTTOM AND FOUR SIDES OF LOAD
FASTER DRYING OF MATERIAL

Freshly Charged Refuse
CANNOT SMOTHER BURNING REFUSE ON LOWER GRATE

Final Burning Grate
SHAKING OR FULL AREA DUMPING GRATES OPTIONAL
EASY FIRE CLEANING



Steel Water-Jacketed Nichols Decarie Basket-Grate Refuse Incinerator.

Charging Hopper
LARGER OPENING
AUTOMATIC BALANCED DOORS PREVENT INRUSH OF COLD AIR

Steel Water Jacket
PROVIDES STEAM FOR HEAT OR POWER
LONG LIFE — LOW UPKEEP

Basket-Grate
EASY STOKING
SHORTER STOKING TOOLS

Stoking Doors
WATER-COOLED DOOR-FRAMES PROVIDING LONG LIFE

Nichols Decarie Suspended Basket-Grate Refuse Incinerators are designed with either water cooled or refractory lined walls and can be equipped with either shaking or full-dumping grates.

Because Nichols Decarie Suspended Basket-Grate Refuse Incinerators require smaller buildings and are more efficient, longer lasting, and in performance invariably exceed the specified requirements, they deserve the serious consideration of everyone interested in the most efficient and most economical incineration of refuse.

NICHOLS

ENGINEERING & NERCO RESEARCH CORP.

60 WALL TOWER NEW YORK, N. Y.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 52 to 57

Treating Supernatant Liquor

It is almost impossible to remove dissolved solids from supernatant but removal of the suspended material is a great help. Thermophilic sludge is especially difficult; odor control may be as important as solids removal. Chlorine reduced odors, but they returned on addition of coagulants unless the chlorine demand had been satisfied. Moderate quantities of ferric chloride produces good floc but considerable sludge. Partial neutralization of alkalinity did not permit material reduction in coagulant; but lowering pH to 3.4-4.0 and addition of ferric chloride produced good floc, rapid settling, compact sludge and clear liquor; alum was less effective. Raising pH to 10.4 with lime produced fair settling but rather voluminous floc.

Mesophilic supernatant was successfully clarified with ferric chloride. Neutralization of part or all of the alkalinity by sulfuric acid did not greatly reduce the coagulant dose and set up undesirable reactions. Lime reduced the coagulant demand considerably, gave good clarification and a compact, rapidly settling sludge; lime water was more effective than lime in suspension, both with and without ferric chloride. Alum was unsatisfactory either alone or with acid, alkali or lime. Bentonite gave good clarification with rapid sedimentation and compacting of the sludge. Calcium chloride was detrimental to treatment with Fe Cl_3 and alum. The best results were obtained with ferric chloride and lime, lime alone, and Bentonite. Both thermophilic and mesophilic liquors could be clarified readily with 10 to 15 lb. of lime per 1,000 gal. in conjunction with 4 to 6 lb. of ferric chloride.[C20]

Centrifuging Activated Sludge

Peoria, Ill., tested for 6 months a continuous-feed centrifuge furnished by the De Laval Separator Co., treating one-fourth of the city's sewage. An average of 1824 gph of waste activated sludge, 1.02% solids, was screened (large solids clogged the centrifuge screen) on Robbins "Vibrex" screen, which removed 3.2% of the solids; the centrifuge delivered 294 gph of concentrated sludge, 4.77% solids, containing 76.3% of the solids in the unscreened sludge, while the remaining 20.5% was returned to the aeration tank as centrifuge effluent containing 0.25% solids. Thus the sludge was reduced in volume 78.5%.

The centrifuge consists of an 18" bowl driven by a 10 hp motor at 6,000 rpm. It will handle only viscous sludge, not gritty materials. The maximum satisfactory rate with Peoria sludge was 1800 gph of 1% sludge. Power used, 9.3 kw. Cost of centrifuge complete $7,000; of screen, $800; of erection, wiring, etc. about $800. Cost for all Peoria sludge, 3 screens and 5 centrifuges, $41,100; annual cost $12,700 (including fixed charges) for concentrating 2190 tons of dry solids per year, or $5.79 per ton; about 14 mgd of sewage with 300 ppm of suspended solids, much from trade wastes.[C19]

Chemical Precipitation at Waukegan, Ill.

Since July, 1937, Waukegan has been testing out chemicals for precipitation in its new plant, using ferric chloride, alum, lime and sodium silicate neutralized with sulfuric acid. Of different proportions of alum and silica, 1.5 g/g of alum plus 0.2 g/g of SiO_2 seemed to give the best results, with a large floc. The floc with alum alone was fine; the reduction in B.O.D. and suspended solids on unchlorinated effluents were comparable to those with alum and silica. Cost for chemicals, based on last summer's prices, would be: alum alone (2

PROTECT YOUR HEALTH

Measure, Mix and Feed Chlorine Gas Accurately For Water Works, Swimming Pools, and Sewerage Purification with EVERSON SterElators.

EVERSON SterElators are the best from every standpoint. Dependable, accurate, safe, easy to operate. A wide range of capacities. Priced as low as $475.00. Guaranteed to give complete satisfaction.

SterElators by Everson

WRITE FOR FREE BULLETIN 1014-PW

EVERSON MFG. CO.

213 W. HURON ST., CHICAGO, U.S.A.

Use PFT Equipment in Your Sewage Treatment Plant

Write for Latest Bulletins

PACIFIC FLUSH TANK COMPANY

Designers & Manufacturers of Sewerage and Sewage Treatment Equipment

4241 RAVENSWOOD AVE. CHICAGO, ILL.

EXCLUSIVELY SINCE 1893

441 LEXINGTON AVE. NEW YORK, N. Y.

HEAVY-DUTY INCINERATION

MORSE BOULGER DESTRUCTORS

FOR THE

INCINERATION OF MUNICIPAL WASTES

GARBAGE, RUBBISH, SEWAGE SCREENINGS AND SLUDGE

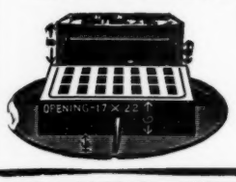
FOR COMPLETE INFORMATION CALL OR WRITE

MORSE BOULGER DESTRUCTOR CO.

HOME OFFICE: 216-P East 45th St., New York, N. Y.

STREET, SEWER AND WATER CASTINGS

Made from wear-resisting chilled iron in various styles, sizes and weights



MANHOLE COVERS, WATER METER COVERS, ADJUSTABLE CURB INLETS, GUTTER CROSSING PLATES, VALVE AND LAMPHOLE COVERS

Write for Catalog and Prices

SOUTH BEND FOUNDRY CO.

Gray Iron and Semi-Steel Castings

SOUTH BEND, IND.

THE OPERATION OF WATER TREATMENT PLANTS

Copies of the April PUBLIC WORKS containing the outstanding instructional text for small and medium sized water works are still available. $1.—*and worth it a hundred times over!*

Book Dept., PUBLIC WORKS, 310 East 45th St., New York, N. Y.

When writing, we will appreciate your mentioning PUBLIC WORKS.

g/g) $3.32 per million gal.; anhydrous ferric chloride (1.5 g/g), $4.88; alum and SiO_2 (1.5 and 0.2 g/g respectively) with sulfuric acid, $3.85. The results indicated that the alum and silicate combination was the best treatment at that time.[C27]

Sludge Drying And Incineration

In burning wet materials it is more economical to separate the drying cycle from the burning because the temperature of evaporation is much lower than that of combustion. Flash drying is efficient for drying sludge. There are 17 sludge flash drying and incineration units in the United States, 11 in Chicago producing 470 tons of dry solids a day, 3 in Buffalo, N. Y., producing 90 tons. The dried sludge can be used as fertilizer, or burned to produce the heat needed for drying.[C25]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*
January

18. Application of the Photronreflectometer for the Measurement of Turbidity in Sewage. By H. W. Gehm and E. H. Trubnick. Pp. 3-8.
19. Concentrating Activated Sludge With a Continuous Feed Centrifuge. By L. S. Kraus and J. R. Longley. Pp. 9-18.
20. High and Low Temperature Digestion: Supernatant Liquor Treatment With Chemicals. By W. Rudolfs and H. W. Gehm. Pp. 19-34.
21. Incinerating of Sludge—Some Governing Principles. By A. R. Smith. Pp. 35-42.
22. Digestion Experiences at Aurora, Ill. By W. A. Sperry. Pp. 43-50.
23. Effect of Sludge Concentration and Temperature Upon Oxygen Utilization. By C. N. Sawyer and M. S. Nichols. Pp. 51-67.
24. A Comparison of the Performance of Imhoff Tanks Against Primary Settling Tanks. By W. S. Mahlie. Pp. 68-71.
25. Sludge Drying and Incineration. By D. C. Reybold. Pp. 72-84.
26. Storm Water Sewer Design. By W. B. Redfern. Pp. 85-92.
27. Chemical Treatment at Waukegan, Ill. By H. G. Swope. Pp. 93-99.
28. First Year's Operation of Wards Island Sewage Treatment Works. By W. Donaldson. Pp. 100-116.
29. Packing for Pumps. By B. Livingstone. Pp. 117-120.
30. Control of Chlorination. By A. C. Beyer. Pp. 120-123.
31. Biological Indicators of Intensity of Stream Pollution. By M. S. A. Campbell. Pp. 123-127.
32. Eight Years' Experience in Imhoff Tank Operation. By J. Hastie. Pp. 127-129.
33. Belgrave Sewer District Sedimentation and Separate Sludge Digestion. By H. O. Johnson. Pp. 129-131.

D *The Surveyor*
March 3

15. *p*. The Kessener Brush Aeration Process. By A. R. Ward. Pp. 345-347.
16. *p*. The Evils of Cesspool Drainage. By J. R. Barron. P. 352.

March 17

17. *p*. The Kessener Brush Aeration Process. Discussion. Pp. 423-424.

March 27

18. Estimating Impervious Area in Run-off Calculations. By L. B. Escritt. Pp. 431-432.
19. Protection of Sewerage Systems from Aerial Attack. By P. M. Gough. Pp. 439-441.

E *Engineering News-Record*
March 16

9. Pollution Control—By Whom? By I. M. Glace and C. F. Browning. P. 42.
10. Sewage Treatment for a Seaside Resort (Virginia Beach, Va.). By W. M. Johnson. Pp. 47-49.

March 30

11. Engine Using Sludge Gas Fuel Gives Low Operating Cost. Pp. 60-61.

G *Water Works & Sewerage*
March

10. Sludge Filtration. By L. W. Van Kleeck. Pp. 91-95.
11. Sewage Disposal in Germany. By K. Imhoff. Pp. 99-102.

J *American City*
March

4. Digester Gas a Source of Income (at Fort Dodge, Ia.). Pp. 55-56.
5. The Hanover, Pa., Sewer System and Sewage Treatment Plant. By C. A. Eckbert. Pp. 63-64.
6. Sewer Cleaning in West Hartford, Conn. P. 69.
7. Chlorination of Sewage at Minneapolis-St. Paul. Pp. 79, 81.

K *Proceedings, Am. Soc. of Civil Engineers*
March

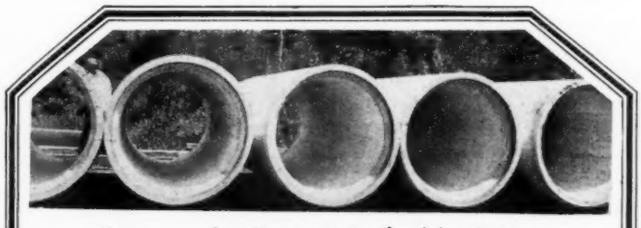
2. Pollution of Boston Harbor. By A. D. Weston and G. P. Edwards. Pp. 383-418.
3. Design of Circular Concrete Tanks. By G. S. Salter. Pp. 419-428.

L *Civil Engineering*
March

3. Technical Aspects of Refuse Disposal. Committee Report. Pp. 166-168.

P *Public Works*
March

14. Solving Sewage Problems at the New York World's Fair. By C. Baldwin. Pp. 9-11, 45.
15. Sewer System and Modern Sewage Treatment Plant for Town of 500. Pp. 16-17.
16. Small Clamshell Bucket Reduces Catch-Basin Cleaning Costs. By R. L. Anderson. Pp. 21-22.



See our advertisement in the March issue

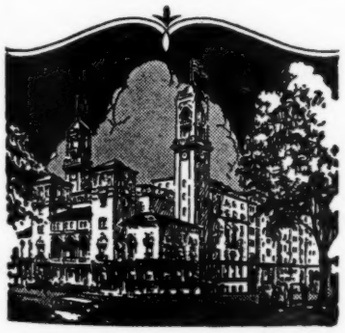
LOCK JOINT PIPE CO. Est. 1905. Ampere, N. J.
Pressure : Sewer : Culvert : Subaqueous

LOCK JOINT
REINFORCED CONCRETE PIPE

INQUIRIES INVITED on all
Problems of Water Treatment

We serve as skilled contractors to furnish and install the complete hydraulic and mechanical equipment in all forms of water treatment plants.

ROBERTS FILTER MFG. CO.
640 COLUMBIA AVE. DARBY, PA.



ENJOY traditional Virginia hospitality in an environment of elegance and refinement at The Jefferson, outstanding hotel of the Old Dominion. Recently completely refurbished with every modern convenience and luxury. Superb cuisine. Rates no higher than at less finely appointed hotels. Williamsburg Restoration, Jamestown, University of Virginia, Skyline Drive within easy driving distance. Write for 32-page Book on "Historic Richmond," sent gratis.

★

The JEFFERSON
RICHMOND, VIRGINIA • WM. C. ROYER, Manager

Complete equipment for Filtration, Softening and all other kinds of

Water Purification PLANTS

Dry Chemical Feeders
Swimming Pool Filters

Consult us any time—no obligations.

E. W. BACHARACH & CO.
Rialto Bldg., Kansas City, Mo.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 52 to 57

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Double Check Valves

In Connecticut there are 151 active installations of double check valves on cross-connections, 44 Grinnell or Eastwood all bronze; 107 iron body with bronze mounting of which 51 are Grinnell, 25 Ludlow, 19 Chapman, and 1 to 4 each of 5 other makes. They are tested by the State Dept. of Health once every four months. Of 6,823 tests made from 1927 to June 1938, there were 122 leaks in outside valves, 17 on inside valves, 7 in both valves; but only one leak in both valves since 1929. All-bronze valves are better than iron body, as rust tubercles grow on the iron near the clapper and interfere with its seating. In New Bedford, Mass., 1933 to 1937, quarterly inspections of 83 installations showed only one case of one valve leaking, none of both leaking. Rubber facings have an average life of 10 yrs.—some 25 yrs.[B1]

Demands of Fire Protection

Use of modern automobile fire engines has increased fire demands on water distribution systems. Even small villages have pumpers of 500 gpm or more, and larger towns up to 1,250 gpm. The old unit of 250 gpm. for a fire stream no longer holds; 300 to 1,000 gpm. are now common. The demand per hydrant may reach 1,000 gpm. Pressure at the hydrant, however, may fall to 20 or even 10 lb., whereas 50 lb. was necessary when pumpers were not used. Increased demand may necessitate larger and better designed hydrants, and larger mains to feed them. It is recommended that dead-ends be eliminated; all 4″ pipe removed, and no new pipe smaller than 8″ be used; congested high-value areas be gridironed with 12″ mains; pipe system be so gated that not more than 2 hydrants be affected by a shut-off; and a good sized hydrant be provided for each 110,000 sq. ft. of occupied territory, reduced to 40,000 in high-value sections.[B8]

Concrete Pipe for the Colorado Aqueduct

Pre-cast concrete pipe is used for 36 miles of the upper feeder of this aqueduct. Diameters, from 9′ 8″ to 12′ 8″; heads up to 292 ft.; backfill up to 20 ft. For 26 mi. of high head, Lock Joint Pipe Co. steel-and-lead joints are used. In casting, the concrete was consolidated along the face by using a 0.5″ square steel rod rotated at 500 rpm, pushed down into the concrete along the face of the form and moved slowly around the face, giving very smooth surfaces and costing less than 1 ct. per sq. ft. of surface.[A34]

Irrigation Increases Salinity

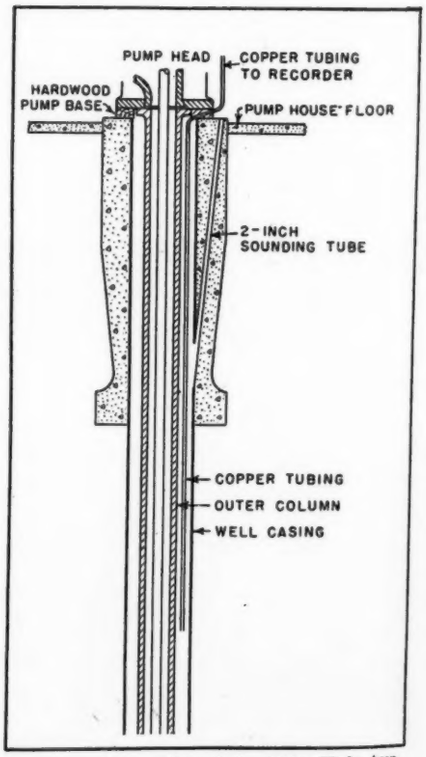
The Rio Grande at Del Norte, Colo., has a salinity of 110 ppm. After being used near Albuquerque for irrigation this becomes 427; at El Paso it is 832, and at the lower end of the El Paso Valley it is 2,120 ppm. Diversion of water from the upper part of the river will increase the salt content of that further down. Samples of water from different depths in Lake Mead show a stratum of about 50 ft. containing a much smaller quantity of dissolved mineral salts than the main body of the lake. It is estimated that the long-time average dissolved mineral salts in Parker reservoir will be about 600 ppm. and hardness 300 ppm.[A33]

Water Level In Pumping Wells

Long Beach, Calif., obtains continuous records of the water level in each of 18 wells, showing the rise and fall as pumping rate varies, the exact time of starting and stopping each pump; showing static elevation above sea level when the pump is idle. The pressure in the main into which the water is pumped is shown on the same chart, and a comparison of the two reveals some interesting and valuable relations; ex. soundings taken a few minutes after the starting or stopping of a pump may vary as much as three or four feet from those taken a few hours later; the effect of starting to pump a well on water level in adjacent ones; the sensitivity of the water level in a pumping well to the increase in main pressure due to cutting in a second well. The recording equipment consists essentially of a ¼ in. pipe lowered into the well below the level of any possible draw-down and connected at the top with a recording gauge, air being pumped into this pipe until all the water has been driven out, and a slight amount—less than a cu. ft. a minute—continuously to prevent water rising in the pipe. Cost of equipment, $231.50 each, and about $1.40 a month for power.[A49]

Manholing Fire Hydrants

Placing around a fire hydrant a manhole built up of concrete rings 33″ inside diameter and 4″ to 12″ high, permits easy access to the entire hydrant and its branch valve, which is connected to its base by flanged joint. If tree roots enter the drain hole, they can be removed. If ground water enters the hydrant through it, the hole can be plugged and water drained out. The hydrant barrel can be removed for repairs or replacing. The cost of the manhole does not ordinarily exceed $10 or $12 per setting, and reduction in maintenance cost and more dependable operation are worth more than this.[A47]



Journal, Am. Water Works Assn.

Long Beach water level recorder

at your Service

INSURES PALATABLE
NUCHAR
DRINKING WATER

When you order Aqua Nuchar you receive a product that is backed by over 25 years of constant research and technical development in activated carbons. For the past nine years Industrial Chemical Sales has concentrated its attention on the problems of water purification. Today, the service of our technical staff, who have acquired wide knowledge and experience in water plant taste and odor control, is at the disposal of any water official in need of advice or assistance without any obligation.

INDUSTRIAL CHEMICAL SALES
DIVISION WEST VIRGINIA PULP & PAPER COMPANY
230 Park Avenue - New York
CHICAGO 205 W. Wacker Drive
PHILADELPHIA 1322 Widener Bldg.
CLEVELAND 417 Schofield Bldg.

Water-Borne Outbreaks During a 17-Year Period

During the period 1920-36, 470 water-borne outbreaks occurred in the United States and Canada (including private and semi-public as well as public supplies but limited to those where 5 or more persons were affected) of which fairly complete data are available. These include some of the most disastrous outbreaks in history. Unusual weather conditions are a major influence in pollution of supplies; the "human equation" is a contributory factor in too many instances, especially where water purification is relied upon for safety. There were 1423 cases of amebic dysentery and 28 of jaundice in addition to more than 16,000 of typhoid, 100,000 of gastro-enteritis and 2,000 of bacillary dysentery. Of the total number of oubreaks, 46.5% were in the Middle Atlantic and East North Central states; over 30% were where the water was from underground sources—largely shallow wells. Of 358 outbreaks in the United States, 51.1% occurred from July to October inclusive; in Canada, 59.2% occurred from February to May. There is need for more strict supervision over the supplies of communities of under 5,000 population, including summer resorts, schools, employee camps and public institutions. There are too many instances of laxity of operation of purification plants and chlorination equipment. Cross-connections between public and private systems was one of the major causes of epidemics. There were 25 communities where more than one outbreak occurred during this period. The courts have definitely established the legal responsbility of public and private corporations for liability for such outbreak, awarding large sums as damages in more than 13 cases.[A51]

Snow Gauging and Stream-Flow Forecasting

Stream-flow forecasting for almost all purposes must be expressed ultimately in terms of the hydrograph of flow, and in regions of heavy snowfall this includes measurement of snowfall. The U. S. Weather Bureau has developed a variation (by J. C. Alter) of the Marvin gauge, provided with flexible or swinging shields, and during 1937-38 had 20 stations with 5 gauges to a station, most at elevations more than 7,000 ft. above sea level. The gauges are charged with calcium chloride to prevent freezing of the contents, and with a film of light turbine oil to prevent evaporation.[L5]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

A *Journal, Am. Water Works Ass'n*
February

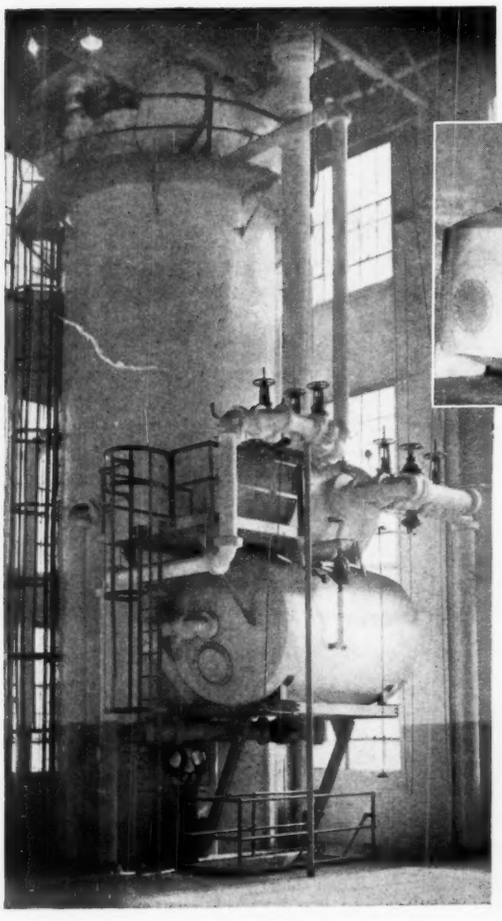
46. Ground Water Replenishment by Surface Water Diffusion. By R. M. Roper. Pp. 165-185.
47. Manholing Fire Hydrants. By V. A. Somers. Pp. 186-189.
48. Water Problems at the New York World's Fair. By B. Eisner. Pp. 190-199.
49. Automatic Water Level Recorder for Wells. By W. M. Brown. Pp. 200-212.
50. Symposium on Filter Bottoms: Slat Bottom Filters. By C. J. Lauter. Wheeler Bottom Filters. By J. S. Gettrust. Pp. 213-224.
51. Water-borne Outbreaks in the United States and Canada, and Their Significance. By A. E. Gorman and A. Wolman. Pp. 225-373.
52. Typhoid Fever in Minneapolis and Gastro-enteritis in Milwaukee. Committee Report. Pp. 374-387.

D *The Surveyor*
February 24

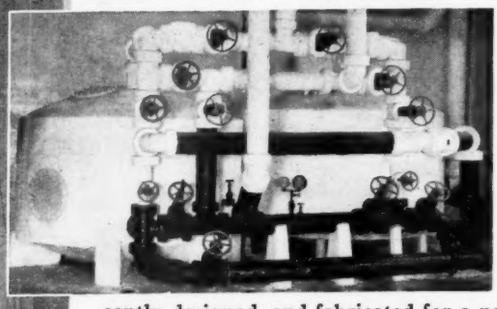
12. London's Water - Safeguards Against Pollution. Pp. 311-313.
March 10
13. Rural Water Supply: Southeast Cornwall Board. Pp. 371-372.
14. *p.* Underground Water Supplies. By J. P. Le Grand. Pp. 379-382.

E *Engineering News-Record*
March 16

12. Selling Good Will With Good Water. By J. O. Herr. Pp. 56-58.
13. Fifty Years of Water Resources Study. By J. C. Hoyt. Pp. 58-59.
March 30
14. Delaware Water for New Jersey. Pp. 50-51.
15. Measuring Dam Behavior. By D. McHenry and R. W. Carlson. Pp. 58-60.



30,000 GALLONS PER HOUR
BOILER WATER TREATING PLANT



WATER HARDNESS REDUCED
From 15 to ½ Grain Per Gal.

This Boiler Water Treating Plant... capacity 30,000 gallons per hour... is a combination HOT Process Water Softener and Condensate Treating installation . . . a thoroughly modern plant planned to utilize previously existing water treatment chemical feeding equipment in a practical manner . . . recently designed, and fabricated for a nationally prominent manufacturer by GRAVER TANK & MFG. CO., INC., East Chicago, Indiana.

THE CONDITIONS and . . .

Heat and treat raw water (hardness, 15 gr. per gal.) 18,000 gal. per hr. Heat condensate, 12,000 gal. per hr. De-aerate the composite of condensate and treated water, 30,000 gal. per hr. Gravity-feed treated water from reaction tank through filters to de-aerating heater. Final hardness of water to be not more than 1 grain per gal. Total oxygen in final water to boilers to be not more than .03 c.c. per liter. Chemicals, lime and soda only.

THE RESULTS!

Hardness of filtered treated-water reduced to ½ grain per gal. (18,000 gal. per hr.). Temperature of treated water to filters, 215° F. Temperature of water at condensate heater outlet, 227° F Temperature of final water from de-aerating heater, 227° F. (30,000 gal. per hr.). Total oxygen in final de-aerated water (.000 to .025 c.c. per liter) ANOTHER TYPICAL SUCCESSFUL GRAVER INSTALLATION!

GENERAL STEEL PLATE CONSTRUCTION
GRAVER
TANKS
WATER CONDITIONING EQUIPMENT

Graver engineers are ready to cooperate . . .
Mail your inquiries to

GRAVER TANK & MFG. CO., INC.
4956 Tod Ave., East Chicago, Ind.
New York, N. Y. East Chicago, Ind. Chicago, Ill.
Catasauqua, Pa.

F *Water Works Engineering*
March 1

21. Booster Pump Replaces Pressure-Reducing Valve. By H. R. Sherman. Pp. 242-244.
22. Pickling Liquor as Coagulant. By J. S. Gettrust and C. O. Hostettler. Pp. 245-248.
23. *p.* Grading Water Supplies for Fire Protection. By R. Bennett. Pp. 250-251.
24. Cost Basis for Using Chlorine as a Liquid or as Hypochlorite. By H. B. Foote. Pp. 255-256.
25. Caisson Well Construction for Briarcliff Manor, N. Y. By P. Manahan. P. 257.

March 15

26. Is Goiter Water Borne? By C. M. Stanbury. Pp. 302-304.
27. *p.* Iron and Hardness in Water and Methods of Removal. By D. J. Saunders. Pp. 310-313.

March 29

28. Maintenance Methods at Cleveland, O. By N. N. Wolpert. Pp. 358-362.
29. Softened Water for Clarksburg. By S. G. Highland. Pp. 363-366.
30. Intake Cribs of Cleveland, O., Water Works. Pp 371.

G *Water Works & Sewerage*
March

11. Water Works Improvements at Charlotte, N. C. By J. B. Marshall and C. S. Rawlins. Pp. 83-90.
12. Improving the Bacterial Quality of Water. By J. R. Baylis. Pp. 96-98.
13. *p.* Operations on Under-River Pipe Line at Bath. By M. A. Libby. Pp. 103-107.
14. The Continuous Stability Indicator. By L. H. Enslow. Pp. 107-108.
15. Algae Straining (by Rotary Screen) at Menasha. By J. H. Kuester. Pp. 112-113.

J *American City*
March

4. Flexible Treatment of Water Checks Tastes and Odors. Pp. 46-48.
5. Good Design and Operation Characterize Greenwood, S. C., Water Works. Pp. 52-54.
6. Water Rates and Service Charges in 8 Cities. Pp. 83, 85, 87.

K *Proceedings, Am. Soc. of Civil Engineers*
March

2. Water Supply Engineering: Progress Report of Committee. Pp. 429-446.

L *Civil Engineering*
March

4. Conservation of Water Through Recharge of the Underground Supply. By A. T. Mitchelson. Pp. 163-165.
5. Weather Bureau's Mountain Snowfall Work. By M. Bernard. Pp. 173-175.

P *Public Works*
March

17. *p.* Water Supply for the New York World's Fair. Pp. 12-13.
18. Testing Wells for Drawdown. P. 23.
19. Reducing the Alkalinity of Well Waters. P. 23.

Recovery for Water Supplied Outside City Limits

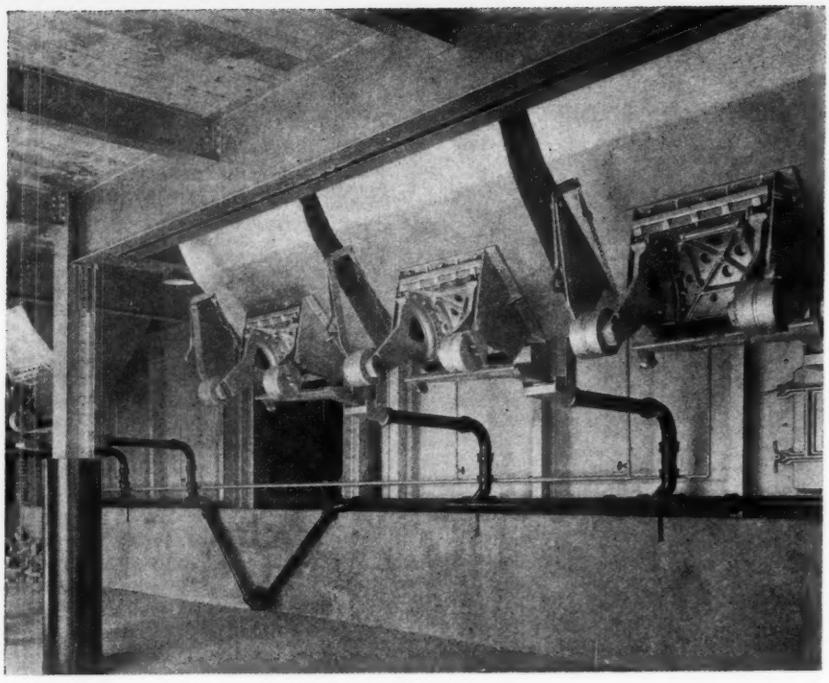
The New Jersey Court of Chancery holds (Home Owners' Loan Corp. v. City of New Brunswick, 1 Atl. 854) that in the absence of a statute expressly authorizing it, or making arrearages in water rent a lien on the lands, a municipality owning or controlling waterworks and supplying dwellers and other customers with water in another municipality has no right to cut off the water supply unless and until the arrears due from a former owner are paid. The city's right to shut off the water in the premises in question if they had been located within the city's boundaries was not and, the court said, could not be questioned.

Engineer's Fees for Abandoned Contract

An engineer was engaged by a water district to plan and supervise the construction of a water supply and distribution system, his compensation to be 6 per cent of the cost of the work. The contract bid was $500,000. The state commission rejected the plans and a new district of reduced area was formed by a special statute. The contract bid for the new district was $341,855. The engineer was paid 6 per cent of this amount. He had also been paid $10,000 by the commissioners of the original water district, who sought to recover this sum on the ground that the payment to the engineer was $10,000 more than was legally due him under his contract with the district.

The second Circuit Court of Appeals (McCarthy v. Potts, 99 F, 2d. 784) affirmed judgment of the Federal District Court for southern New York, dismissing the complaint on the ground that when the district abandoned constructing the kind of water plant originally proposed, defendant could have withdrawn from his undertaking altogether; that he had a just claim for the value of the services he had rendered and could properly keep the money he had received in payment of it; that he had settled his claim for $10,000 and entered into a new agreement to act as engineer for 6 per cent of the cost to the new district of the new and entirely different plant. The questions involved were held purely of fact and were determined by the jury. The payment was held not extra compensation forbidden by the state statute, but for services not covered by the contract under which the plans for the new district were made.

for LOWEST COST PER GALLON
$85 F.O.B Factory
JAEGER BANTAM
Weighs only 52 lbs. Pumps 4000 G.P.H. at 30 ft. head.
COMPACT 2", 3", 4", 6" MODELS— 7,000 to 90,000 G.P.H.
8" and 10" Pumps, up to 220,000 G.P.H.
Prime Faster!
Pump More Water!
Pump More Hours!
Use JAEGER Sure Prime Pumps
Only in a Jaeger do you get the Patented Priming Jet for fastest known 100% automatic prime, Patented Lubri-Seal for long-life, perfect sealing, Patented Self-Cleaning Shell and Jaeger Open Impeller for handling dirty water in maximum volume, without clogging or a sign of wear, thru thousands of hours of heavy service. Jobs are safer, dewatering costs lower with a Jaeger. Get our Catalog and Prices.
THE JAEGER MACHINE CO.
400 Dublin Ave., Columbus, Ohio



Charging gates for a modern incinerator

Suggestions for Planning for an Incinerator

A city of 6,000 population wants a refuse incinerator and WPA assistance in building it. Probably a company experienced in building incinerators will construct it, but what capacity should it have? What requirements should be specified? What should be the general design of the building to house it? These questions were put to us, and the answer is given in this article.

A FLORIDA city of about 6,000 population, which had in mind the contracting for an incinerator, has asked for suggestions on what data they should collect and additional procedure necessary in connection with seeking to obtain WPA assistance in securing an incinerator. At our request A. E. Stillson, president of Morse Boulger Destructor Co., has made the following suggestions.

First it is necessary to know how much material per day will have to be incinerated and its nature. It is customary in smaller plants or cities like your own to operate a plant but eight hours per day, while it is usual practice in the incineration field to rate plants on a 24-hour basis. Therefore, if you have 6 or 7 tons of material collected per day, your plant will have from 18 to 21 tons nominal rating per 24 hours.

To make the process as clean as possible, we suggest that you consider charging the material directly from the floor upon which the trucks enter the building. This charging floor should be well drained and have an area of approximately 25 sq. ft. for every ton of nominal rated capacity. This is to say, for a plant of 20 tons capacity, about the minimum floor area we should have would be 500 sq. ft. This floor should be designed for at least 250 lbs. of live load. It should preferably have a concrete cove base around the entire floor. Above the base we suggest a salt-glazed brick dado about 3 ft. high. Salt-glazed brick are practically non-absorbent and are easily cleaned.

To permit the trucks to maneuver and dump their load, it is desirable to have 16 ft. in the clear beneath the lower chord of any truss supporting the roof above, which will accommodate a 14 ft. door. The door should be of rolling steel and at least 12 ft. wide, preferably 14 ft. Cast iron or steel wheel guards should be provided with the door.

Stairways from the charging floor to the stoking floor beneath should be enclosed if possible, to prevent material falling down into the stoking room below. The stoking floor we believe should be approximately at grade. It should be designed for about 150 lbs. live load.

The incinerator itself will be connected to the charging floor by means of charging chutes. We recommend two charging chutes, as this gives an opportunity to feed the material more evenly into the furnace than is the case where only one charging opening is supplied. Each charging opening should be at least 30" in diameter to readily take down a large box or barrel without having to break it up. The charging chute should be refractory lined with a steel shell, and with a slip joint provided in the steel shell so that expansion and contraction will not tend to crack the charging floor.

The charging opening in the floor should be framed with steel structural members and provided with a cast iron collar set flush with the floor surface and extending down into the charging chute. The firebrick lining should not come in contact with the cast iron collar, but an expansion joint should be left at this point suitably backed with heavy asbestos rope to make it substantially smoke-tight. The charging holes should be provided with heavy cast iron covers which should be supplied by the manufacturer. The covers normally are refractory lined or air-cooled, with a cast iron liner to protect the main body of the cover.

We recommend that the unit be purchased complete erected in place by the incinerator manufacturer. This recommendation is based on experience with the WPA. It is true that it requires a slight addition to the funds set forth by the city, since WPA can purchase materials only. On the other hand, greater added satisfaction is derived where the incinerator manufacturer erects with his own labor.

There are several ways of incinerating material. In larger plants, preheaters are indicated as means of augmenting the combustible rubbish which is the principal fuel. In smaller plants, however—let us say under 50 tons—the over-all economy of the preheater, after maintenance, etc., have been considered, is doubtful. We recommend in smaller plants that either soft coal or oil be used as fuel. As coal is relatively expensive in Florida, we assume that probably you will want to use oil. We recommend that the oil burner be bought and installed by the oil burner manufacturer, thereby taking advantage of their skill and guarantees. A maximum of 200 lbs. of coal (or its equivalent) per ton of 100% wet garbage containing moisture up to 70% probably will be sufficient. Where rubbish is available in proportions of at least 25% rubbish with 75% garbage, the fuel requirements disappear except in extremely wet weather which has existed for some period of time.

Modern practice in larger plants has dictated the use of ash tunnels together with ash hoppers underneath the furnace, and water-cooled gates. Our suggestion is that your plant probably will not be large enough to justify the extra cost involved. If you wish ash handling equipment, you must expect to increase the height of the building at least 10 ft. so that trucks may enter under the ash hoppers and the gates. The ash hoppers themselves and the gates are expensive. If you decide to use them, they should be supplied as part of the incinerator equipment and erected by the incinerator manufacturer.

We have found that in your type of climate it is perfectly safe to estimate the length of ramp on the basis of a 10% grade. The average light truck will turn through 90°, or a radius of about 18.3 feet. With this information you will be prepared to lay out your own ramp and turning platform. The turning platform area we figure on is something like 20 ft. per ton of capacity. The turning platform may be eliminated if you desire to turn the truck before it enters upon the ramp and back up the ramp.

For chimney, we recommend one of radial brick fully lined with firebrick throughout its entire height; preferably erected in place by the chimney manufacturer himself.

Transporting Sand in Pipe Lines

The principal results of a theoretical and practical study by O'Brien and Folsom, the University of California, of the transportation of sand-water mixtures in pipe lines are: (1) Above the critical velocity, the head loss in any given pipe line is the same as would occur with clear water at the same mean velocity, and the pressure drop increases in proportion to the specific gravity of the mixture. (2) At a given discharge, the head developed by centrifugal pumps, expressed in terms of the mixture being pumped, decreases materially as the percentage of concentration is increased. The experiments in this paper deal, in the main, with the movement of quartz sand and fresh water through horizontal pipe lines. The conclusions are believed to be valid for other, similar combinations.—*Road Abstracts.*

When father was a boy

Even so short a time ago as our father's generation, there was still much localized resentment against installing "these damnfangled costly water systems". "If our water was good enough for my father to drink . . ." was heard in many a town meeting of that time.

Today, the typhoid rate of North America is the lowest in history . . . adequate confirmation that liquid chlorine is doing its job well.

Solvay's new "Big 3" Liquid Chlorine Service is designed to fulfil the requirements of modern water purification and sanitation systems. This service is not only designed for quick and convenient delivery of Liquid Chlorine. It is a service system upon which State and municipal authorities can depend for adequate supplies in times of emergency . . . upon which they can depend for advice and technical assistance when it is required.

Solvay Liquid Chlorine shipments are now routed from Syracuse, New York; Hopewell, Virginia; and Baton Rouge, Louisiana. Your inquiries on Solvay Liquid Chlorine are cordially solicited. Please write to the nearest branch office listed below.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET NEW YORK, N. Y.

BRANCH SALES OFFICES:

Boston•Charlotte•Chicago•Cincinnati•Cleveland•Detroit•Indianapolis
New Orleans•New York•Philadelphia•Pittsburgh•St. Louis•Syracuse

SOLVAY

TRADE MARK REG. U. S. PAT. OFF.

LIQUID CHLORINE

When writing, we will appreciate your mentioning PUBLIC WORKS.

Sewage Disposal Problems of Unsewered Municipal Areas

SEWERS, in most cities and villages, do not serve every house. Even where they do, there is always a more or less densely populated area just beyond the corporation limits. The proper disposal of sewage in these areas, both within and without the city or village limits, is important in a number of ways. Most important, of course, is the danger to health that is inevitable when these wastes are improperly disposed of. Other considerations include the probability of nuisance and the methods and equipment used in scavenging. Allied with the problem is the fact that city water is usually available in these areas, but many continue to use wells and springs that may be and usually are of doubtful quality.

One reason for the almost astonishing lack of progress in solving this problem has been that responsibility has been divided, if there has actually been any responsibility. Health officials have pressed for correction of the sanitary defects in these areas, solely on the grounds of health protection. Engineers have refused to look on it as their problem, being concerned primarily with sewer extensions. There has been a mistaken feeling that methods of disposal other than by sewers are generally unsatisfactory. Finally, there has been an unwillingness to insist upon proper construction because of the cost involved, even though (1) the cost is usually no greater than that for making sewer connections, and may be less; (2) the service received in return is practically as trouble-free as that from sewer connections; and (3) there is usually no hesitation in requiring connections to sewers when these are available.

Statements (1) and (2) may be questioned. The facts are that a septic tank with proper secondary disposal under most conditions can be constructed for considerably less than $100; if soil conditions are favorable, the cost may not exceed $70. This is for all items outside of the house, but does not include any house plumbing, of course. In regard to service obtained from properly installed septic tanks, experience shows that there should be practically no more trouble and no more expense over a 10 to 20-year period than with sewer connections. Of several thousand tanks installed in a Southern city more than 15 years ago, the very great majority are still giving satisfactory service, and the maintenance costs have been negligible. Such service is, indeed, the rule rather than the exception.

The important factor is proper installation, which includes both the tank and the disposal field. Without proper installation satisfactory results cannot be expected except under the most favorable conditions of soil and drainage.

The factors that should be observed are, in regard to the tank: (1) ample size; (2) good design; (3) workmanlike installation; (4) proper location; (5) rigid inspection before approval and covering.

There are many differing opinions as to what constitutes ample size. In general, any capacity of 300 gallons or more in a well-designed tank is sufficient for the average one-family home. Actually, more depends upon the care in laying out and designing the secondary disposal system than upon the size of the septic tank. Good design means that the tank must be so constructed that short-circuiting is avoided; the depth must be adequate; and the inlets and outlets properly placed and protected by down-turning elbows or tees.

Workmanlike installation is perhaps most important, since even a septic tank that is slightly inadequate in capacity will give good service if well-installed. The inlet must be above the outlet, or clogging will occur; when using a metal tank, this must not be tipped back toward the inlet; concrete tanks must be watertight, or enough moisture may seep out to permit the solids to clog the tank. Forms in concrete tanks must be carefully keyed for removal, thoroughly soaked before using, and properly removed without injuring the tank. Concrete of the correct water-cement ratio must be used to avoid honeycombing and leaks; light reinforcement is generally necessary.

Location is also important. If the tank is placed where it is subject to flooding from surface run-off, or where the eaves drip on it, satisfactory operation cannot be expected. Also, placing a tank and disposal field in a low, wet area subjects the installation to serious handicaps. Generally, septic tanks should be placed slightly away from the house (but not necessarily very far); on as high ground as possible; in a well-drained location; and not too deep. Avoid trying to care for cellar fixtures in the main septic tank unless the slope of the land is such that connections from these can be brought near the surface of the ground within a reasonable distance. It is better to construct a small separate unit to care for wastes from cellar fixtures.

A grease trap is most desirable, but not an absolute necessity in the average one-family home installation. When serving a restaurant or any place where grease may be a considerable factor, a trap is a necessity.

Rigid inspection presupposes that regulations have been drawn up governing the installation of septic tanks and cesspools. Such regulations should provide for sizes and types of tanks, of course, but the most important item is the requirement that a permit be taken out for the installation of septic tanks. Whether this permit should be granted by the health department, the clerk or the public works or engineering department is not very important. The inspection that is necessary before the installation is important. It should be made by a man familiar with construction work, for which reason the engineering department is preferable, as it is the details in construction that are most important. It is difficult, if not impossible, to write specifications that will insure a good job without inspection, because so much depends upon the construction details.

This is equally important in connection with the details of final disposal, the procedures in which will depend to a considerable extent on soil and drainage conditions. As a rule, the subsurface tile disposal field is the most satisfactory method of disposal of the septic tank overflow. Essential elements in this are (1) adequate area, considering the type of soil—generally 75 to 120 feet of tile laid in broken stone, gravel or cinders; (2) a maximum grade or fall of not more than 4 or 5 inches in 100 feet; (3) maintenance of exact grade along the whole length of the line; (4) protection of open joints against clogging of dirt backfill; and (5) location in areas of low ground water and away from surface wash.

New Type of French Road Surfacing Material

A new material which may be used either as a road surfacing or for traffic markers in roads surfaced with other materials, has been developed in France by the S. A. des Colorants et Plastiques (Fr. Pat. 826311). In their patent, the manufacturers recall that colophony can be made to give resinates of metallic oxides which have a much higher melting point than the colophony itself. These resinates are too brittle for use in their pure form, but they can be rendered plastic by the addition of either rubber or siccative oils, and treatment with sulphur. The quantity of sulphur determines the exact characteristics of the mixture as to resistance and plasticity.

As an example of the possibilities of this system they suggest a mixture comprising 250 grams of colophony, 150 grams of zinc resinate and 50 grams of essence of turpentine in which 2.5 grams of rubber have been dissolved. The colophony is melted by heating to about 80° C. and stirring it thoroughly. The zinc resinate is then added and the temperature raised to 160° C. to melt it, mixing being continued the whole time. When the mixture is completely homogeneous, a quantity of powdered pumice filler, which has previously been treated with sulphur chloride or sulphur chloride and carbon disulphide, is added and mixed thoroughly, together with the turpentine solution of rubber. The mixture solidifies at about 70° C., and can be used either for surfacing or for markers. In the latter case it is desirable that coloring matter be added to the mixture before solidification. This should be an alkaline color, the patent suggesting fuchsin or rhodamine for red, auramine or methylene yellow for yellow, methylene blue or indenthrene for blue, and Russian green for green colorings. For anti-skid surfaces this mixture may be loaded with either sand or gravel.

The above information is abstracted from a report in *Roads and Bridges,* an English technical publication.

California Developments in Road Markers

In order to reduce accidents, new road markers indicating safe speeds are being placed in California. Accident records indicate a high percentage of driving-off-the-road and turning-over accidents occur at curves, the contributing factor being too much speed for turning the curve. Safe speeds at curves are being determined by expert drivers using specially prepared equipment. These curves are then marked with the proper speed.

Reflector units are also being placed to indicate the edges of the roadway. Each unit consists of three discs, 1.62 ins. in diameter, placed one above the other in a vertical position in an enameled frame on a post, and about 40 ins. above the highway. Units are placed on both sides of the posts, and posts are placed on both sides of the highway, 100 feet apart on tangents and 50 feet apart on curves; posts are located 10 ft. from the edge of the pavement. This is an extension of the practice of using similar reflectors at bridge approaches and other danger points.

Another method of guiding traffic consists in having recessed panels in the curbing of the center dividing strip on divided highways. These recesses are then painted so as to reflect light back to the driver, improving greatly the visibility of the curb.

The only pavement with a

FACTORY MADE

Safety Surface

Only brick pavements have a traffic surface that is made in a factory under positive control. Hence, a highly uniform surface. And one that can be inspected before it is put in place. Modern methods of filler application further develop its non-skid properties.

And, in addition to a maximum degree of safety, brick offers the lowest cost per year of any pavement! More than any other modern pavement, brick is highly resistant to weather damage. Brick that have served two score years and more in severest service are being reclaimed and relaid on new bases.

Brick pavements have the best record for low cost wear. Use on roads or streets—for new construction or resurface jobs. National Paving Brick Association, National Press Building, Washington, D. C.

BRICK

FOR NEW AND RESURFACING JOBS

When writing, we will appreciate your mentioning PUBLIC WORKS.

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

Construction Materials and Equipment

Air Compressor from Ford Parts

5. How you can convert an ordinary Ford model A or B motor into an air compressor for operating jackhammers, paving breakers, clay spaders, tampers, paint sprays, etc., is explained in a new bulletin just issued by Gordon Smith & Co., Desk G, 516—10th St., Bowling Green, Ky.

Cold Mix Plants

10. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride with Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42d St., New York, N. Y.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Dirt Moving Efficiency

65. "Dirt Moving," is a new 32 page booklet illustrating the use of Trac Tractors as a source of money-making power for bulldozers, bullgraders, wheel scrapers, fresnos, graders, dump wagons, tampers, etc. 24 pages of action pictures, directions, etc. Sent promptly by Internaional Harvester Co., 180 No. Michigan Ave., Chicago, Ill.

66. Where loading is done by hand, the Load Lugger, with your small truck, will cut costs tremendously. Simple, low in price. Especially adapted to city, county and town work. Complete details on request. Brooks Equipment & Mfg. Co., 56 Davenport Road, Knoxville, Tenn.

67. "Modern Methods of Moving Earth" is an 88-page illustrated book explaining earth moving by tractor power. Tells what types of equipment is most efficient for each class of work and includes estimated costs of the different methods on average jobs, short cuts in estimaing, etc. Sent only to those having earth moving problems by Cleveland Tractor Co., 19,300 Euclid Ave., Cleveland, Ohio.

Finisher

78. A very complete, 36 page illustrated booklet on the Barber-Greene Tamping-Leveling Finisher explains its important features, principles of operation, types of jobs it handles and materials laid. Ask for catalog 879, Barber-Greene Co., 635 West Park Ave., Aurora, Ill.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Mud-Jack Method

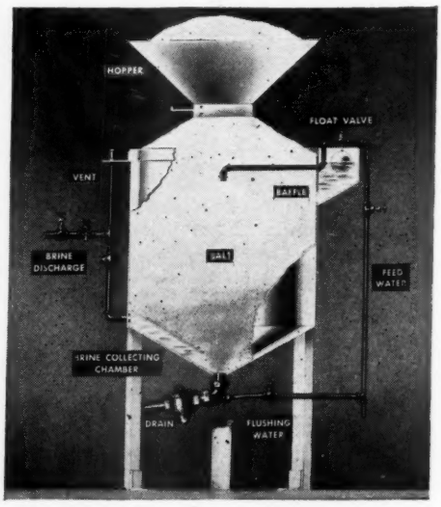
107. How the Mud-Jack Method for

(Continued on page 53)

Keeping Up With New Equipment

Lixate Process for Making Brine:

This process produces a fully saturated, perfectly clear brine from rock salt, without stirring or any labor other than a periodic drawing off of the collected impurities and washing of the inside of the Lixator. Salt is used that does not cake in the hopper. This flows into the cylindrical Lixator, fresh water meantime flowing in through a spray nozzle and percolating through the salt, dissolving it. A bed of undissolved salt about a foot deep in the bottom of the cylinder serves as a filter to remove any undissolved material. The bottom of the cylinder is conical, and a false bottom is set a short distance above and parallel to it. The clear brine collects between these two bottoms and flows out as needed.



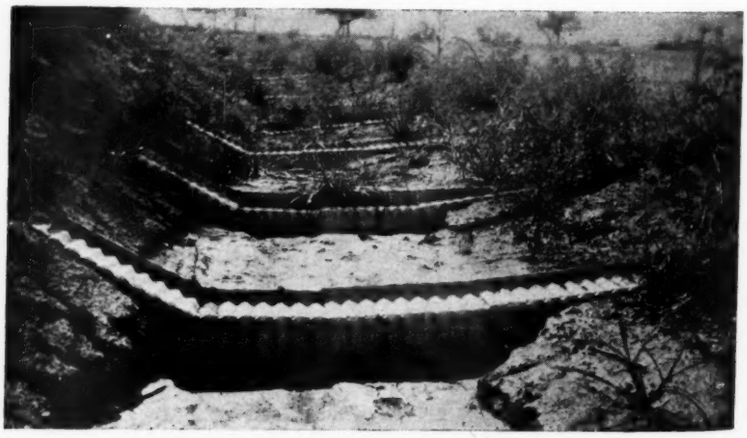
How the Lixate process works

Labor is thus reduced to a minimum —there is no stirring, handling of salt, operating filter. etc. Rock salt is used instead of the more expensive refined salt, and there is no waste of salt. The brine is clear, since there is no agitation, and saturated. The process is leased to users of International Rock Salt.

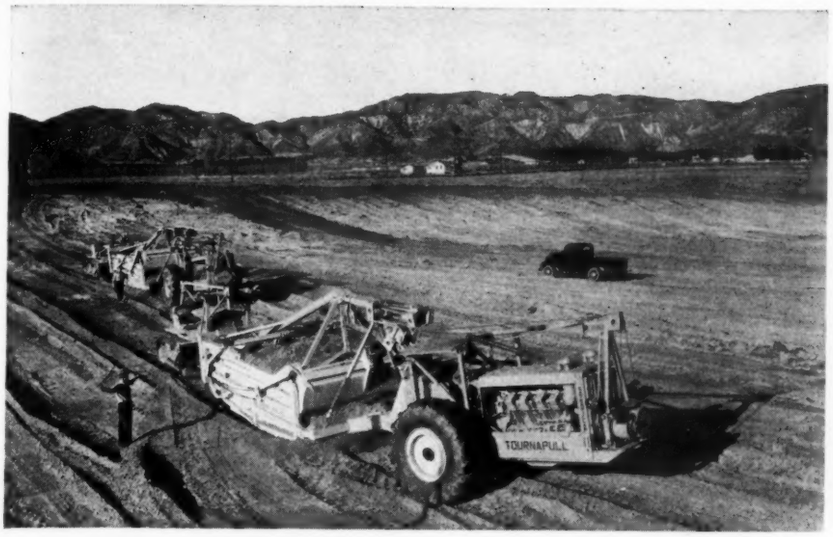
The Central Ditch Check

Erosion of ditches along highways can be controlled by the installation of ditch checks, as made by the Central Culvert Company of Ottumwa, Iowa. These checks are composed of one or more units, of 16 gauge iron-copper alloy sheets with 2½" corrugations, and 25½" wide overall, with net covering width of 24 inches, when unit is lapped one corrugation by adjoining unit. The drain is 2' high, the apron 8" wide, and the anchor 10" deep. They are shipped nested 6 in a bundle. Weight per standard unit 11 pounds; the bundle 66 pounds. All units are given a heavy zinc spelter coating.

Installation is quick and easy—a maul being the only tool needed. Units are driven into the ground to the anchor plate in the bed of the ditch, with as many additional units flanking the center units as may be required to complete the dam, each unit overlapping the adjoining unit one corrugation. The bend that forms anchor and apron comes at the driving point, giving a solid driving surface. The apron receives the fall of the overflow on a non-eroding surface. In driving the check into position the soil is not disturbed; no excavation is necessary.



This shows installation of Central ditch checks



Le Tourneau's "Tournapull" is moving dirt

Something New in Dirt-Moving—the Tournapull

LeTourneau's answer to the request for a machine that will handle more dirt faster and cheaper is the Tournapull, which combines the capacity of the largest self-loading unit—30 cu. yds.—with fast truck speeds under its own power. Loads of 30 yards can be handled at 17 miles an hour, with ordinary ground conditions; more under good conditions. Hauls exceeding a mile can be handled economically.

For the hauling units, either the 30-yd. Tournatrailer or the 30-yd. carryall scraper can be used with the 165 hp. power unit. The former is a rear dump buggy, which must be loaded by shovel, dragline or elevating grader; the latter is a self-loading unit. While the carryall scraper can be handled by the Tournapull power unit, time studies have shown that loading time is decreased by as much as 50 to 60%, and pay loads increased 20% by the use of a pusher tractor. The power units uses 24-inch pneumatic tires.

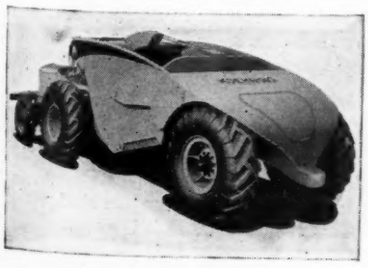
New Equipment by Koehring

The latest and newest method of dirt-moving is the Koehring Wheeler. The power of a push crawler tractor is utilized to furnish the necessary effort when loading and only when loading. Koehring uses a rubber tired tractor with speeds of 18 to 20 miles per hour, for traveling to and from the dump. The push tractor loads another Wheeler when others are traveling to the dump, thereby requiring only one push tractor for a fleet of wheelers. The Koehring tractor has been used for the Koehring Trail-Dump for 5 years. Wheeler units and Trail-Dump wagons are interchangeable for use with the Koehring tractor.

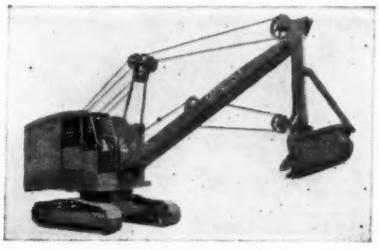
Two new sizes in pull shovels have been developed by Koehring—Models 251 and 303. Outstanding improvements are reduction in weight, due to use of lighter but stronger steels, longer reach with increased speed for the hoist line; better vision; easy dumping; and fast swing speed.

Koehring Stripping Shovel

Another development is the Koehring 702 Stripping Shovel. This machine is furnished with an extra long boom (33 feet) and dipper stick (27 foot) which are distinct advantages for the disposal of dirt to high dump piles in stripping operations. Deep cuts are efficiently made, with a wide level floor, reducing excessive material handling.



Koehring rubber tired tractor



Koehring Pull Shovel

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

(Continued from page 52)

raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. An excellent booklet issued by The Barrett Co., 40 Rector St., New York, N. Y., describes and illustrates the uses of each grade of Tarvia and Tarvialithic; 32 good illustrations.

Paving Materials, Gutters

119. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Road Building and Maintenace

126. See road work as it was done in the 1890's and as it can be done by a full line of this year's road building equipment. See, in this new action picture book, the first reversible roller, 1893 World's Fair Award Grader and how methods have changed. Attractive new booklet AD-1796 recently issued by The Austin-Western Road Machinery Co., Aurora, Ill.

127. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalog 200 issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Rollers

130. New bulletin describing in detail the new Huber Road Rollers will be sent promptly on request by the Huber Mfg. Co., Marion, Ohio.

132. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3846 No. Palmer St., Milwaukee, Wis.

Shovels, Cranes and Excavators

145. The Austin-Western-Badger, a fully convertible ½ yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A-5 Aurora, Ill., is fully described and illustrated in their Bulletin No. AD-1683.

146. New catalog picturing the detailed construction of Osgood "Chief" power shovel and illustrating it as shovel, clamshell, dragline, crane and piledriver. Write The Osgood Co., Marion, Ohio, for your copy.

Spreader

147. Jaeger Paving Equipment, including Mix-in-Place Roadbuilders, Bi-

(Continued on page 54)

Readers' Service Department

(Continued from page 53)

tuminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Soil Stabilization

152. The Columbia Alkali Corporation, Barberton, Ohio, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing The Columbia Alkali Corporation, Barberton, Ohio.

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Company, 40 Rector St., New York, N. Y.

Steel Forms

160. Complimentary Bulletin S-19-F, issued by The Heltzel Steel Form and Iron Co., Warren, Ohio, contains complete information on the use of steel forms for constructing concrete curbs, curb and gutters and sidewalks.

Trailers

170. A fast loading and fast hauling trailer is illustrated and described in a 12-page folder by Meili-Blumberg Corp., New Holstein, Wis. The platform tilts for safe, easy, one-man operation. Initial cost is low, up-keep negligible, capacity up to 10 tons. Write Beili-Blumberg for folder.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

Pouring Pots

265. Full line of welded, screened and hooded pots, light, strong and accurately balanced, designed for maximum savings. Send for literature and prices to Tarrant Mfg. Co., 12 Maple Ave., Saratoga Springs, N. Y.

Street Cleaner's Can Carriers

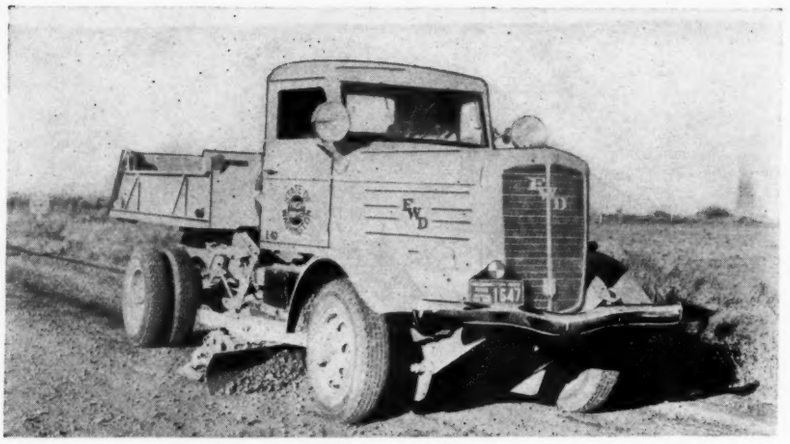
290. "Street Sweepers' Friend," an improved roller bearing and rubber tired can carrier is described and illustrated in a new pamphlet which will be sent promptly on request by the Tarrant Manufacturing Co., Saratoga Springs, N. Y.

Sweepers, Rotary

300. "Frink Roto-Broom" a 4 page bulletin illustrating and describing a new rotary sweeper by Frink. Attaches to front of and makes a sweeper of any motor truck. Used by street and highway departments, parks, airports, playgrounds, arenas, coliseums, etc., for sweeping dust, dirt, sand, gravel, cinders, leaves or snow. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

HOW TO ORDER: These booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

(Continued on page 55)



FWD Model HG Road Maintenance Unit

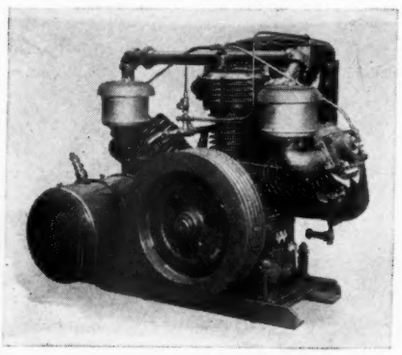
FWD Road Maintenance Unit

Two new truck units have been announced by Four Wheel Drive Auto Co., Clintonville, Wisc. These are the Model HG road maintenance unit and the T-32 for semi-trailer service. The maintenance unit has 23-inch road clearance for the installation of an underbody grader or scraper. The blade with which the unit is normally equipped is held in position and under constant control by levelizers and the action of hydraulic rams, controls being located in the cab. This model (the HG) has a 91 hp. engine and a speed up to 33 mph.

Worthington Power Take-Off Compressor

To fill the requirements of a special field, Worthington Pump and Machinery Corporation of Harrison, New Jersey, has developed a portable air compressor with power take-off drive. It consists essentially of a Worthington compressor driven through a Worthington Multi-V-Drive by a Hercules drive unit installed between the truck transmission and the front universal joint of the propeller shaft.

The compressor is the three-cylinder two-stage radial air-cooled type used on the standard Worthington portable mountings, and includes many modern features of construction: the improved Feather Valve, ring-type fins, large sectional type intercooler, articulated connecting rods, force-feed lubrication, and by-pass unloading.

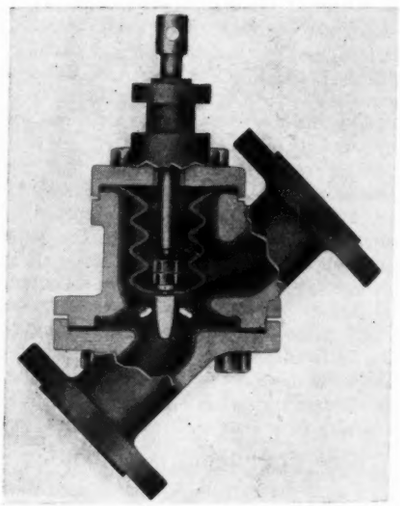


Worthington power take-off compressor

A new bulletin illustrating various applications of the new mounting, with complete specifications, has been issued. Write for Bulletin H-850-B55.

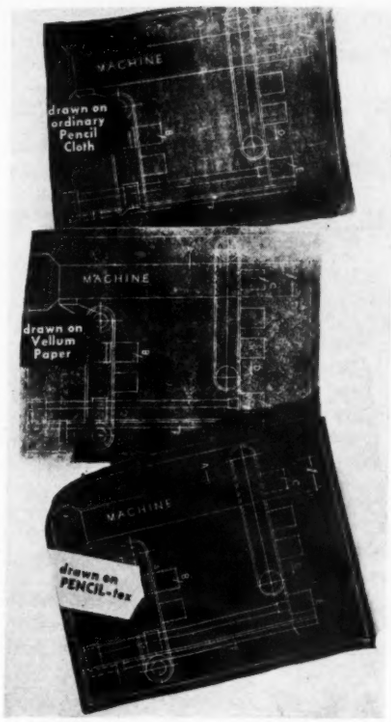
Acid-Proof Flow Control Valve

A flow control valve completely and permanently protected against corrosive attack has been developed by Hasco Valve and Machine Company, Milwaukee, Wisc. Although the valve is designed primarily for regulating the flow of ferric chloride solution into sewage treatment processes, it can be used with any acid except hydrofluoric, fuming sulphuric or highly oxidizing re-agents. It cannot be used with strong alkalis. The rubber lining is applied by The Goodyear Tire & Rubber Company. This type of construction was proved by a test valve which operated for eight months in a Chicago sewage treatment plant.



Hasco Acid-Proof Valve

The valve is made for regulating purposes only. It is not a shut-off valve. It is designed to be operated by an Askania ratio regulator which maintains a metered proportion between the sludge and ferric chloride flow. This is accomplished by using the sludge flow as an actuating impulse.



Results with Pencil-Tex drafting cloth at bottom

Pencil-tex Drafting Cloth—Get Your Sample

Frederick Post Co., Box 803, Chicago, Ill., have a "try-it-yourself" kit that will be sent on request. This illustrates what you can do with their new pencil-text drafting cloth; they claim that a 5H pencil drawing makes a clear and beautiful reproduction, just as good as ink. Pencil drawing is much faster and easier than ink—for us anyway, but the prints do not reproduce as well, on ordinary tracing paper. The kit mentioned will give you a chance to decide for yourself.

The Sargent Overhead Shovel

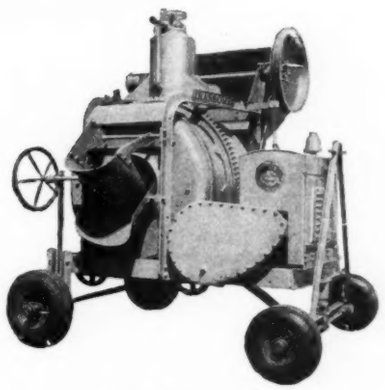
A new 3/8-yard overhead shovel has been announced by Maine Steel, Inc., South Portland, Me. This is mounted on a BG or BD Cleveland tractor and takes its power from the tractor. Especial advantages include convertibility to a bulldozer or to a snow-loading shovel. A bulldozer blade can be installed in 15 minutes, the shovel bucket being locked overhead and to the rear. A 1½-yd. bucket is used for handling snow. Larger buckets can be used with larger tractors.

The loading operation on this shovel is interesting. The bucket is filled by backing up the tractor into the bank. The bucket is then swung overhead and dumped into the truck or other hauling unit. The bulletin that has been put out on this machine is most interesting. It will be sent on request. Ask the manufacturer for a copy.

Sargent Shovel on Cletrac

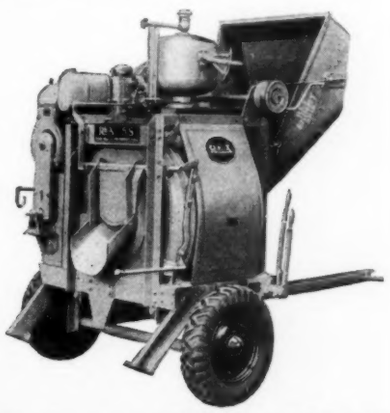
Ransome Developments For Concreting

Ransome Concrete Machinery Co., Dunellen, N. J., have announced two new concrete mixers, the 7-S and the 10-S, which have a number of features of interest. These are described fully in a 16-page booklet replete with diagrams, mixing action illustrations and other data. Ask for Bulletin 154, to obtain all the details.



New Ransome Mixer

Ransome is also announcing a reservoir for storing wet concrete. This is a steel receiving and discharging hopper for receiving a full load of truck-mixed concrete, permitting the truck mixer to go on its way. It then dispenses the mixed concrete to wheelbarrows or carts as needed. Full data on request.



This shows one unit of the complete new line of Chain Belt mixers, which are made in 3½, 5, 7 and 10 ft. sizes. Full data. Chain Belt Co., Milwaukee, Wisc.

Readers' Service Department

(Continued from page 54)

Snow Fighting

Plows

349. "Frink V Type Sno-Plows" is a 24 page catalog fully illustrating and describing 8 models of V Type Sno-Plows for motor trucks from 1½ up to 10 tons capacity, 16 models of Frink Leveling Wings, the Frink Hand Hydraulic Control and the latest Frink Selective Power Hydraulic Control. Data are given for selecting the proper size V plow and wing for any truck. Issued by Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Sanitary Engineering

Anaylsis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use," is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

375. This concise folder No. 1294 describes "Straightline Aerators" for activated sludge treatment; combines these features: 1, rapid circulation in the tanks; 2, exposure of large surfaces, hastened oxidation and bacteriological growth. Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

380. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Aerators for Sewage

381. New 24 page booklet, No. 6571 describes and illustrates the Dorrco Paddle Aerator and also the Turbo-Aerator. Also contains a discussion of the activated sludge method of treatment with much interesting data and illustrations, including a section of "Useful Information." Issued by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. Cast Iron Pipe has beam strength, resistance to crushing stresses and infiltration-proof joints making it highly desirable for flow lines, force mains, submarine lines, outfalls and sewage treatment plants. For specifications write U. S. Pipe and Foundry Company, Burlington, N. J.

Chemical Treatment

385. A handbook on the application of chlorine and iron salts in sewerage treatment. Tech. Publication 177. Wallace & Tiernan Co., Inc., Newark, N. J.

Diesel Engines

386. Write Dept. 118, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago, Ill., for data on how the installation of F-M diesels has lowered taxes and made it possible for many communitines to pay for their improvements out of municipal power plant earnings.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from %Proportioneers, Inc.% 96 Codding St., Providence, R. I.

388. Chemical Feed Machines. Description, principles of operation; data on installation. E. W. Bacharach & Co., Rialto Building, Kansas City, Mo.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

(Continued on page 56)

Readers' Service Department

(Continued from page 55)

Flow Meters

391. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Garbage Incineration

392. Send for full information about the Decarie Suspended Basket-Grate Garbage Incinerator which solves the garbage disposal problem of any city economically and with a minimum of space. Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Concrete

409. Two excellent booklets, 12 and 16 pps., describe manufacture and installation of reinforced concrete pipe for gravity and pressure lines for sewage and storm drainage. Lock Joint Pipe Co., Ampere, N. J.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

416. For full details of Servitite plastic sewer pipe joint compound which it is declared will positively prevent root growth, write Servicised Products Corp., 6046 West 65th St., Chicago, Ill.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a booklet issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 77 pages, tables, illustrations and usable data.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office, Memphis, Tenn.

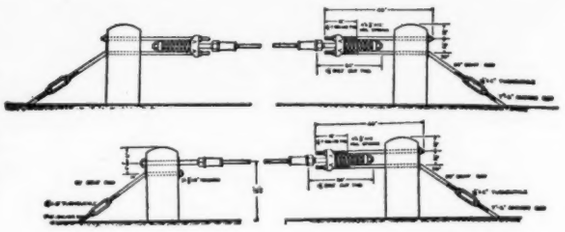
Run-off and Stream-Flow

426. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straight-line Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago Ill.

(Continued on page 57)



This shows the proper end assemblies for the Wej-Lock Super Guard rail. This uses a single 1-inch wire strand, but more strands can be added, if desired. Upper cut shows assemblies for sections 500 to 1000 ft. long; lower cut 100 to 250 ft. Full data. Wej-Lock Co., Centralia, Mo.

New Ingersoll-Rand portable air compressor is air-cooled, available in 5 sizes from 85 to 315 cubic feet of air per minute at 100 lbs. pressure. Powered by gasoline or oil engines. Data and chart for selecting proper size compressor for air tools sent on request. Ingersoll-Rand, 11 Broadway, N. Y.

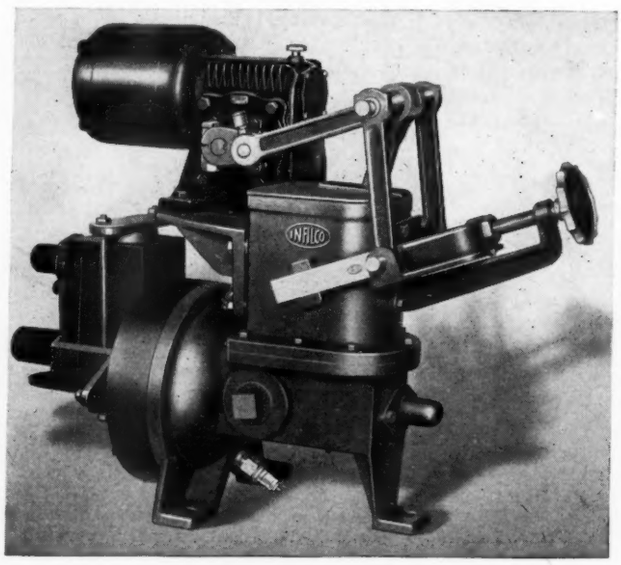
Meili-Blumberg new tilting industrial trailer is made in 5 sizes up to 10 tons capacity. Equipment can be driven onto trailer under own power. Meili-Blumberg Corp., New Holstein, Wisc.

Plunger-Diaphragm Pump for Corrosive Chemical Solutions

The Type DP solution feeder pump for volumetrically measuring and pumping clear corrosive chemical solutions has been announced by International Filter Co., 59 E. Van Buren St., Chicago, Ill. It is completely described in a bulletin available from the manufacturers.

This new plunger-diaphragm type pump is a means of both accurately measuring a solution and pumping it to the point of application. Action is simple and positive. The plunger of the displacement pump actuates a rubber diaphragm through means of a transmission liquid, and the diaphragm in turn, with the solid rubber pumping chamber and valves, actually handles the solution. The liquid comes in contact only with rubber. Any of the transmission liquid that slips past the piston rings is automatically returned through a compensating valve mechanism, assuring sustained accuracy. The transmission liquid is a non-conductor of electricity; should the solution being pumped leak past the diaphragm it would instantly change this transmission liquid to a conductor, close an electrical circuit and sound a warning. A non-congealing or anti-freeze transmission liquid is furnished for operation in freezing temperatures.

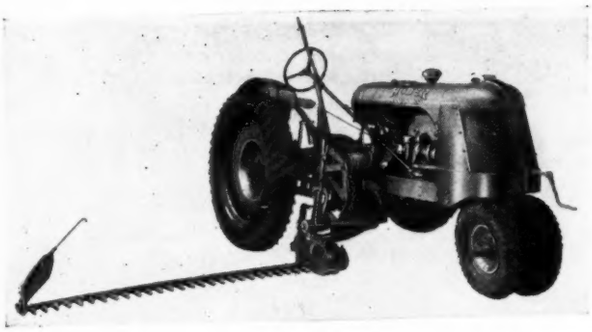
The rate of chemical feed is easily varied, either by adjusting the piston stroke or by changing the speed of the motor or other prime mover. The length of stroke of the piston is regulated by the hand screw on the rate setting arm. Adjustments can be made while the feeder is in operation. Because it is a positive displacement pump, the Type DP will work under conditions of both suction lift and discharge head with a high degree of accuracy.



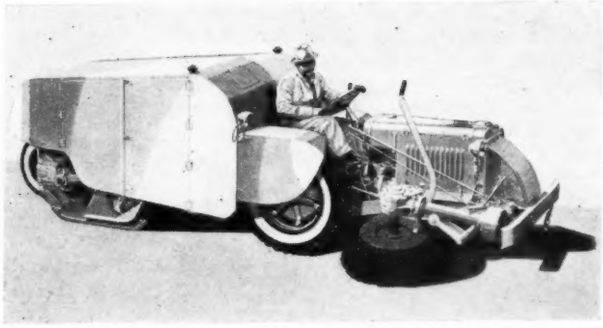
Infilco Pump for corrosive solutions

The Coffing chain hoist has many uses. Coffing Hoist Co., Danville, Ill.

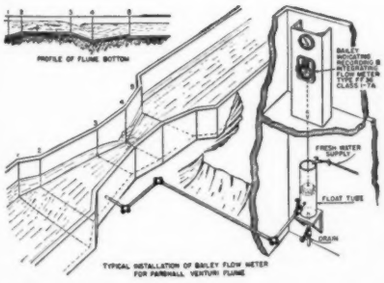
Right: A new road maintainer for all light work. 30 hp. 9-ft. blade control. Full data from Huber Mfg. Co., Marion, O.



Left: This shows a mower attachment for the "B" Huber tractor shown above. Sickle runs at full stroke no matter what angle the bar is held—45° above or 45° below.

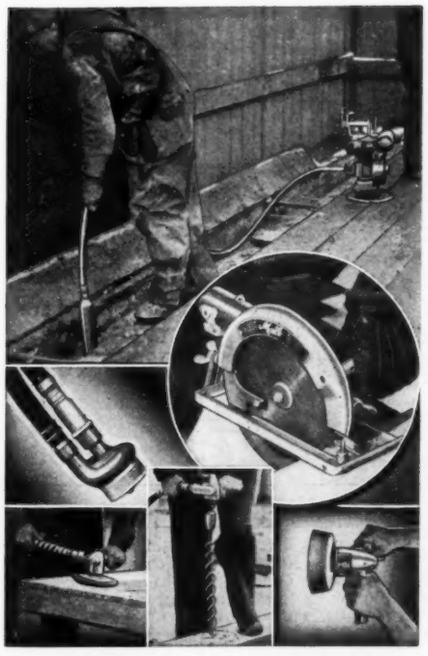


Right: New motor pick-up sweeper for cleaning gutters and sweeping 6-ft. path in the gutter lane. Compact; streamlined. Frank G. Hough Co., Chicago, Ill. Ask for bulletin 112 for complete data.


PROFILE OF FLUME BOTTOM
FRESH WATER SUPPLY
FLOAT TUBE
DRAIN
TYPICAL INSTALLATION OF BAILEY FLOW METER FOR PARSHALL VENTURI FLUME

Weir notch or Venturi flume for measuring water or sewage flows. Bailey Meter Co. Cleveland, Ohio.

Link-Belt vibrating screen at tomato waste plant.



This is the new "Jack-of-all trades" made by Mall Tool Co., Chicago, Ill. Bulletin on request.

Readers' Service Department

(Continued from page 56)

Meter Setting and Testing

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co. Wabash, Ind.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Drying and Incineration

439. The five basic steps of: sludge preparation; flash drying; incineration; deodorization; and dust collection are explained in a new 24 page booklet, No. 6781 issued by The Dorr Company, 570 Lexington Ave., New York, N. Y., sales representatives for the C-E Raymond system of sludge drying and incineration.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 216P East 45th St., N. Y.

Swimming Pools

443. "Pure as the Water You Drink"—a well illustrated booklet of useful data for engineer and contractor, on how to make your swimming pool sanitary, hygienically safe and inviting. Write Graver Tank & Mfg. Co., Inc., 4956 Tod Ave., East Chicago, Ind.

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

446. 40-page Manual on swimming pools. Includes swimming pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

447. "Painting Swimming Pools," an interesting booklet by Dr. A. F. Pistor, covers the subject thoroughly, discussing objectively the relative merits of the different types of coatings recommended for that purpose. Write Inertol Co., 401 Broadway, New York, N. Y.

Treatment

450. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

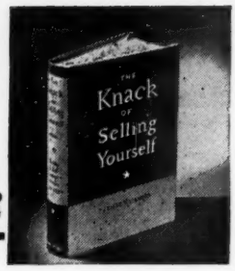
453. New booklet (No. 1642) on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

HOW TO ORDER

To obtain any of these booklets without obligation, send a post card to the firm whose name and address are given in the description and MENTION PUBLIC WORKS MAGAZINE. Or, if you prefer, send your request to Readers' Service Dept., PUBLIC WORKS, 304 East 45th St., New York, N. Y.



256 PAGES
5½x8½ INCHES
SLATE BLUE
AND OLD GOLD
CLOTH BINDING

The Biggest Problem of Your Life—Licked!

The Knack of Selling Yourself

by James T. Mangan

A new and refreshingly different book by the author of "You Can Do Anything" and "Thoughts on Salesmanship."

NOT one person in a hundred has the faintest idea of how to sell his ability. Most just don't know how to go about it. They still believe that if they make a better mousetrap the world will beat a path to their door. So they are pushed aside by those who know how to sell what they have. Engineers are no exception.

A Practical Program

Unlike most books, this one does not stop at telling you WHY—it shows you HOW—with an extensive set of exercises, practical hints, helps and suggestions on simple things to do. No book up to "The Knack of Selling Yourself" has taken up this major human problem in such amazing detail. It charts a course for every man who has latent ability and wants to market that ability at the highest price. It presents the practical "Get There" system of life.

Don't put off reading this helpful book. Send only $2.50 in full payment with the understanding that you may return it within 5 days for full refund if not entirely satisfied.

Order Your Copy Today

Book Dept., PUBLIC WORKS,
310 East 45th St., New York, N. Y.

For the enclosed $2.50, send me one copy of "The Knack of Selling Yourself." If for any reason I am not fully satisfied, I will return the book within 5 days and receive my money back.

Name.....

Occupation.....

Street.....

City..... State.....

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Standards, Codes and Specifications:

The American Standards Association, 29 West 39th St., New York, has issued a booklet listing more than 400 nationally approved codes, standards and specifications, indexed alphabetically and also industrially, according to subject. These represent general agreement on the part of maker, seller and user. This book does not contain these codes, but lists them and shows the designation of each. Sent on request.

Tire Data:

How to select tires, tubes and rims; tire load analyses; effect of inflation on load and tire mileage; dual tire spacing; clearances; chain clearance; rim sizes and rim identification; and lots of other valuable information. Sent on request. Firestone Tire & Rubber Co., Akron, Ohio.

Dorr Clarifiers:

This bulletin covers sedimentation practice of today and the underlying theory of the subject; possibly its most valuable portion is six pages of operating data, representing results at 13 different plants — separate sludge digestion, activated sludge and chemical precipitation. Twenty-two photos illustrate Dorr equipment and the bulletin describes the various types of Dorr Clarifiers in detail. Fine job. Sent on request. Dorr Co., 570 Lexington Ave., New York, N. Y.

Sanitation for a Nation:

This is an attractive 16-page booklet that illustrates and describes progress in sanitation in America. A number of "largest installations" are shown. Copies on request. Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

Sewer Facts:

Here is an excellent book of 72 pages which, in the language of the publishers, contains "valuable information about sewer construction and pipe materials." How clay pipe is made; how it is tested; standard specifications for pipe and for laying; amount of materials required for joints; amount of sewerage; velocity and discharge—these are only a few of the subjects covered. We believe it will be sent on request to Clay Products Association, 111 West Washington St., Chicago, Ill.

FOR SALE

Large Capacity Dragline Bargain

Marion 8-yard capacity steam dragline, 8 years old, original cost $100,000; truck mounted, 150 ft. boom, oil fired boilers recently retubed, all in good condition except cab requires some rebuilding. Price $25,000. Terms $10,000 cash, balance $1,000 per month. Box No. BC, PUBLIC WORKS, Magazine, 310 East 45th St., New York, N. Y.

Index to ADVERTISEMENTS

Activated Alum Corp..... 43
Alvord, Burdick & Howson..... 49
Ashdown, Williams & Co..... 49
Austin-Western Road Mach. Co..... 25
Bacharach & Co., E. W..... 39
Barrett Co., The..... 27
Black & Veatch..... 49
Browne, Floyd G..... 49
Buffalo-Springfield Roller Co..... 29
Burns & McDonnell Engr. Co..... 49
Caird, James M..... 49
Cast Iron Pipe Research Assn..... 2
C. H. & E. Mfg. Co..... 33
Chevrolet Motor Div..... 6
Cleveland Tractor Co..... 4
Cramer & Sons, Inc., Robert..... 49
De Witt Hotels..... 50
Dorr Co., The..... 5
Dow, A. W., Inc..... 49
Everson Mfg. Co..... 38
Frink, Mfr., Carl H..... 28
Fuller & McClintock..... 49
Goodyear Tire & Rubber Co..... 3
Gorman-Rupp Co..... 33
Graver Tank & Mfg. Co., Inc..... 42
Greeley & Hansen..... 49
Green Co., Howard R..... 49
Harrub Engineering Co..... 49
Heltzel Steel Form & Iron Co..... 28
Hill Associates, Nicholas S..... 49
Industrial Chemical Sales Div..... 41
Jaeger Machine Co.....29 & 43
Jefferson Hotel..... 39
Koehring Co..... 31
Layne & Bowler, Inc..... 59
Link-Belt Co..... 48
Lock Joint Pipe Co..... 39
Manual of Sewage Disposal Equipment and Sewer Construction..... 34
Metcalf & Eddy..... 49
Mohawk Asphalt Heater Co..... 28
Morse Boulger Destructor Co..... 38
National Paving Brick Assn..... 51
Nichols Engr. & Res. Corp..... 37
Norton Company..... 23
Osgood Company..... 33
Pacific Flush Tank Co..... 38
Permutit Co., The..... 8
Philadelphian Hotel..... 50
Pirnie, Malcolm..... 49
Potter, Alexander..... 50
Proportioneers, Inc.....Front Cover
Quinn Wire & Iron Works..... 35
Robert & Co..... 50
Roberts Filter Mfg. Co..... 39
Russell & Axon Cons. Engrs., Inc..... 50
San-Equip, Inc..... 47
Serviced Products Corp..... 35
Simplex Valve & Meter Co..... 34
Solvay Sales Corp..... 45
South Bend Foundry Co..... 38
Sterling Engine Co..... 47
Tarrant Mfg. Co..... 30
Wallace & Tiernan Co., Inc....Back Cover
Water Supply and Purification..... 30
Weston, L. A..... 34
Whitman & Howard..... 50
Wiedeman & Singleton..... 50
Wilson Engr. Co..... 50